PUBLISHED

AT NO. 9 MURRAY STREET, NEW YORK.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

W. J. JOHNSTON, Editor and Publisher.
N. S. KEITH, Associate Editor, Scientific Department.
T. C. MARTIN, " " News Department.
E. P. THOMPSON, " " Patent Department.
CLARENCE E. STUMP, Business Manager.

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Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed simply,
THE ELECTRICAL WORLD,
NEW YORK.

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Vol. V. NEW YORK, JAN. 3, 1885. No. 1.

IN spite of dull times the Commercial Cable people have "started in" with remarkable briskness and vim. They say business is good, and at a period when every other man pulls a long face as he meets you and says things are dreadfully dull, it is refreshing beyond bounds to meet folks who are pretty well satisfied with the course of events. We forgive them, even if they do expand their facts with a little gas. There is none too much of the Mark Tapley spirit in the world. The Commercial Cables have our hearty good wishes for the new year.

FRANCE is the land of theatrical projects, whether in war, science, industry or art. To that Republic we are indebted for the remarkable Statue of Liberty, of which none but a Frenchman would ever have dreamed. Now the countrymen of Jules Verne propose to build, as one of the chief marvels of the Exhibition at Paris in 1889, a great Tower of Babel. It is to be 1,000 feet high, tapering from 330 feet in width at the base to 30 feet at the top. The whole structure will be surmounted by a glass pavilion serving as an electric lighthouse. The project is visionary, but it may be carried out long before Bartholdi's Liberty throws its beams of electric light athwart the bay of New York.

SOME time ago Prince Bismarck complained that the telegraph made life a burden to diplomatists. But, alive as he is to the inconveniences of being kept incessantly on the alert by electrical communication, he is also keenly appreciative of the advantages. A recent dispatch from Berlin says that a direct wire connects Prince Bismarck's office with the foreign office at Vienna, and that with its assistance he controls Austro-Hungarian politics. One of these days the office of the Secretary of State at Washington will be connected by wire with the foreign offices of Mexico and Nicaragua, for the better discharge of our duties of "protectorate" over those countries.

DURING the past year THE ELECTRICAL WORLD has contained no fewer than 482 pages of reading. It has also furnished over 800 illustrations, of which about 150 belonged to the Patent Record. It has given a great number of articles by specialists, on questions of the hour. It printed its regular edition by electricity at the Philadelphia Electrical Exhibition for six weeks, and gave what is acknowledged to be the best account of the Exhibition. It was the only paper to report in full the proceedings of the National Conference of Electricians. These are but a few of the reasons why it has such a hold on the confidence and esteem of its readers, and can count on a continuance of their support.

IF there be any meaning in the phrase "sweetness and light," an electric light installation ought to be eminently pleasing to students at our seats of learning. But it appears that a number of collegians at Yale were greatly offended by the erection of an electric light pole at the corner of the campus, and proceeded just before Christmas to chop it down. Since then it has been re-erected, but the students threaten to demolish it, and it is under special police protection. Now, it might be thought by some persons that the æsthetic ideas of the students were the cause of this vigorous protest; but the plain fact is that electricity gives more light than they relish. The Yahoos of Yale are like those of any other place.

THERE has been issued from the Brooklyn office of the New York and New Jersey Telephone Company a very neat circular giving a map of the territory and a list of the stations. Then on a separate page are enumerated the reasons for patronizing the telephone. The argumentum ad hominem is neatly put, and we note among the inducements two that are new, namely, that it gives the opportunity to hear good church music and sermons and to hear the opera. Oratory and opera may have been heard over the telephone wires before, but it is happy audacity on the part of a telephone company to advertise their facilities in this way. Some day, perhaps, there will be a list of "Sunday subscribers," who will be switched on to any church they select. But how about pew rents?

VOLUME FIVE.

With the issue of to-day the fifth volume of THE ELECTRICAL WORLD begins, and we have therefore taken the opportunity to make a few improvements in the form of the paper. The changes most important will at once be noticed by our readers. They consist in the adoption of a cover and the removal of the "editorial page" from the middle of the reading matter to the beginning. The cover is neat and tasteful in appearance, serving equally as ornament and protection, and we have no doubt that it will be heartily welcomed by all. With respect to the other change, it may be said that when so much of a paper is editorial, or original, it seems somewhat improper to apply to one page exclusively the title of "editorial." As we are scrupulous in giving credit for articles transferred occasionally from our contemporaries, it can be taken for granted that the remainder, by far the largest part of the contents, is original. The first page each week will, hereafter, be devoted to brief current notes, crisp and piquant, on the electrical events of the day.

We shall endeavor to keep the paper up to the high level attained last year, and to excel our previous efforts. It is still too early to speak definitely of our plans, but we may state that we propose to publish a series of special illustrated articles on leading subjects of thought and investigation; that great attention will be paid, as heretofore, to our Patent Record; and that the news of the day will be accurately summarized in our departments.

Taxes on Electrical Corporations.

The annual statement of the names of the several incorporated companies liable to taxation in the County of New York has been sent to the State Controller, as required by law. The statement gives the amount of real and personal estate belonging to each company, as the same is set down in the assessment rolls, which have been sanctioned by the Common Council, and the amount of taxes assessed upon each for the year 1884. The rate of taxation is $2.25 per $100. In the following tables, giving the electrical corporations listed, the amount of the tax is omitted, but may be figured out upon that basis. In addition to those paying county taxes upon real or personal estate or both, there will be found a few companies which, under the law of 1881, pay taxes on their personal property to the State directly. These corporations, however, pay a county tax upon their real estate:

	Real estate.	Amt. of stock taxable deducting real estate.
American Electric Lighting	.....	$1,130
Arnoux & Hochhausen Electric	.....	25,000
Brush Electric Illuminating	$53,500	70,105
Edison Company Electric Lighting	.....	100,000
Electric Appliance	.....	750
Electric Tube	.....	27,084
Excelsior Electric	.....	17,656
Jerome Kidder Manufacturing	.....	4,200
Lugo Dynamo Electric	.....	5,000
Photo-Electrotype Engraving	.....	6,000
Solenoid Telephone	.....	5,000
Union Electric Manufacturing	.....	12,366
United States Electric Lighting	175,000	247,477
Westchester Telephone	.....	10,000
Automatic Current & Electric Manufacturing	.....	5,000
Blanchard Electric Light and Power	.....	2,400
Consolidated Electric Light	.....	16,500
Electric Plaster	.....	4,882
New York Applegate Electric Matting	.....	10,000
Raisbeck Electrotype	.....	3,000
Edison Electric Illuminating Co. of New York	33,000	10,000
Paying to State only on personal estate:		
Merchants' District Telegraph & Burglar Alarm Co., Limited		1,927
Gamewell Fire Alarm		52,500
Holmes Burglar Alarm Telegraph		6,000
Mutual District Messenger, Limited		9,759

The Co-operative Building Association.

At a meeting of those interested in this project, which was held December 17, a committee was appointed, consisting of Messrs. Howell, Sabine, Stephenson, Voyer and Irving, to thoroughly investigate all the different plans of co-operation, and submit the most feasible ones at the next meeting, which will be called by the committee.

It is probable that the plan which will finally be selected, will be a modification of the Philadelphia system of co-operation, as it seems to meet with much favor. Mr. W. Marsh, of this city, who was formerly secretary of a Philadelphia society, will probably accept the secretaryship of the new association. A final meeting to effect organization will be called early in January and indications point to a large membership. One prominent official of the Western Union Telegraph Company promises that himself and friends will subscribe for one hundred shares. Other large subscriptions are expected.

Retelling an Old Story.

A dispatch of the 25th Dec. from Chicago says: Local telegraph circles became agitated by reports of the formation of a new and powerful telegraph syndicate, which, it is said, will enter during the early part of the new year actively into opposition to the Western Union. John W. Mackay, of the Postal Company; Robert Garrett, of the Baltimore & Ohio; James Gordon Bennett and the bondholders of the Bankers & Merchants' Company are said to be the moving spirits in the enterprise. These combined interests control over 200,000 miles of wire now in operation, representing a plant valued at about $30,000,000. The first move made will be the payment of $1,000,000 of interest due on contracts of the Bankers & Merchants', and $300,000 more in filling up the gap between Pittsburgh and Steubenville, Ohio, and from Montgomery, Ala., to New Orleans. It is believed that this syndicate means business, and is preparing to secure all the lines not controlled by the Western Union. Col. Clowry, of the latter company, says that such a syndicate would not compel a sudden reduction of Western Union rates.

Telephonic Communication in New Brunswick.

A general meeting of the stockholders of the St. Martins Telephone Company was held at the office of the Bell Telephone Company in St. John, N. B., on the evening of December 23. A committee of three was appointed to carry out details in reference to the incorporation act, by-laws and general business of the company. Mr. Duncan C. Robertson was appointed secretary. At eight o'clock the instruments were placed in position at the Quaco office and communication opened. The first message to Quaco was from W. H. Rourke, conveying intelligence of the loss of the schooner Zamora, and stating that he was going to New London to look after the interests of the owners. The initial message from Quaco was an order from a prominent butcher ordering Christmas delicacies, including 30 lbs. of sausages. A gentleman conversed with Mr. James R. Cochrane, who has charge of the office at Quaco. Every word could be as distinctly heard over the 38 miles of wire as from any point in the city circuits. The instruments will all be in position and communication had with Henry Lake, Salmon River, Gardner's Creek, Black River and Loch Lomond by the 1st of January, adding 16 miles of wire to the line. The company are confident of a most prosperous business resulting from their enterprise.

A Review of Electrical Events and Progress in 1884.

Another year has gone of that life which, with all its achievement, is for all of us so poor a rendering of the hopes and aims that give it inspiration, and the time has come for a review of its happenings and progress. The year, surveyed broadly, has been eventful, determining great issues foreshadowing the accomplishment of mighty projects, and adding its fair quota to solid conquest in the domain of electrical science and application. Our country, equally with the other parts of the civilized world, has passed through a crisis of depression and distress. Commerce has languished, the busy hum of factories has ceased; costly machinery has rusted in idleness; banks have succumbed to the drain upon their reserves; mines have been shut down, and toilers by the hundreds of thousands have sought in vain for employment at the merest pittance. But amid all these signs of dull times, and while suffering a natural sympathetic restriction, electrical industries of all kinds have prospered in the main and grown apace. In spite of startling occurrences, which seemed for the time to throw the mechanism of social and business life out of adjustment, the application of electricity to the perfection of material comfort and the ultimate evolution of society has steadily advanced, and our record bears ample evidence to the gratifying progress made in each and every department.

THE TELEGRAPH.

The oldest line of electrical application continues to be that which is most interesting to the public in this country and most fruitful of striking changes. At the beginning of the year the Baltimore & Ohio Telegraph Company made a move prophetic of competition and warfare. It had not, up to that time, been particularly progressive or aggressive, but it startled everybody by engaging as General Manager, Mr. D. H. Bates, until then Assistant General Manager of the Western Union Company, and by throwing itself with remarkable energy into competition with the "old concern." This step gave the Western Union Company three pushing and active competitors to deal with, and talk soon became rife of an opposition combination of the B. & O., the Postal and the Bankers & Merchants' Company. Annexation and consolidation went on in every direction, the B. & O. buying up the Manhattan District Telegraph Company, the "Nickle Plate" lines, and various lines down South, while the B. & M. added to a miscellaneous conglomeration of lines and systems, including those known as Rapid and Southern. The combination was effected, and as it had the support of such men as Mr. John Mackay and Mr. Garrett, it impressed most people as being strong enough to last and to make a successful fight. But it had hardly been formed before it practically fell to pieces. The financial depression, extending in area and depth ever since President Garfield was shot, culminated in early Summer by a crash in Wall street, and that crash revealed the rottenness of the B. & M. Company, whose promoters were among the first to go under. The stock fell with marvelous rapidity, and having gone over 120 was before the end of the year down to 4 and 5. The allies of the wrecked company forsook it without much delay or compunction, and the company now floats a derelict on the troubled sea of finance, to be towed into port by the first vessel that is strong enough for the job and wants the prize.

As a result of all this competition, a war of rates has been waged, and its benefits have been accepted by the public with equanimity. Down to the present time, rates continue far below the average of previous years, and there is no sign of a change in an upward direction.

The Wall street panic has had a marked influence on the value of Western Union stock. Quoted not far from 80 in January, in June it fell to 50, and it is now below 60. The decline has been ruinous to many speculators and capitalists, among whom may be classed Mr. Keene, a gentleman who, having made a fortune rapidly in the West, is reputed to have come to New York with the amiable intention of "wiping out" Mr. Gould. In many respects Mr. Gould may not be so substantially wealthy as he was at the opening of last year, but he is still far from being wiped out. Despite the active competition and astute diplomacy that he has had to face, the Western Union Company has done a good round business of $20,000,000 per annum, and its last quarterly report estimates a dividend of 1½ per cent. The "regular" dividend of 7 per cent. has become 6, but so long as this is paid out of earnings the most exacting stockholder will not complain in these dull times, when to sell out would do him no good. In fact there has been no good reason why the company, with a system four times the size of the united opposition in mileage of wire, and with facilities that have been built up during long years should not do a good business. Recently, however, there have been indications of a pinch somewhere, and efforts have been made at various points to cut down expenditures by reducing the "extra" of the operators. Provided reduced pay means reduced work, as in other occupations, the operators do not object, but they are still fighting any reduction that is uneven.

The Delany-Calahan multiplex system of synchronous multiplex telegraphy has gone into operation in New England, and is reported a great success. A company was incorporated in February to send and receive messages by typewriter, but nothing definite has since been heard of the scheme. The Commercial Telegram Company has been working the Field ticker very successfully, and is extending itsoperations in the large cities, while the Gold and Stock tickers have been treated with great contumely by leading commercial exchanges East and West, because they have been leased not only to legitimate brokers but to "bucket shops." The struggle is still going on, and the new year finds the G. & S. Co. between two fires, the exchanges threatening a withdrawal of patronage on one hand, and the bucket shops invoking the aid of the law against any discrimination that shall exclude them from use of the tickers. The Postal Telegraph Company is developing its system, but has given up the manufacture of the compound wire from which such great things were expected. A fast-sending contest held in August at "195" developed magnificent form and speed, and the first prize was carried off by an operator who sent 2668 characters—500 words—in 11 m. 27 s. One contestant made the remarkable time of 10 m. 10 s.

The occurrence of the Presidential campaign had a salutary effect on the revenues of the telegraph companies, and led to spirited competition at the conventions held in Chicago. Good work was done by the Western Union and B. & O. Companies, and by the Associated Press and United Press. It is estimated that the "specials" handled for the two conventions amounted to at least four million words. Later on when the Presidential vote had been cast and the greatest anxiety prevailed everywhere to learn the result, bitter and vehement charges were levelled against the Associated Press, to the effect that it was holding back the returns to tamper with them, and to help change the small majority for Cleveland in this State into a minority. The charges have since been investigated and though nothing worse than mismanagement has been proven, the feelings of some people have been strongly expressed again in favor of government telegraphs, so that one of the chief means of communication shall be free of stockjobbing and monopolistic control.

The year saw an active fight for government telegraphs, and a failure to obtain any legislation on the subject. The plans proposed were legion, the most prominent being those to which the names of Senators Edmunds, Hill and Dawe, and Representatives Anderson and Sumner were respectively attached. The interest of the various measures is now chiefly historic, and their differences of principle and detail need not be enumerated, especially as they are likely to be revived in some shape or other during the present session of Congress. The opinion of the country for and against governmental management of the telegraph appears to be very equally divided.

THE TELEPHONE.

The year has not been without its excitements in the telephonic field. First and foremost, it has witnessed what looks like a settlement of the Bell-Drawbaugh suit, the decision rendered in the United States Circuit Court for the Southern District of New York, by Judge Wallace, being adverse to every one of Daniel Drawbaugh's claims. The particulars of the case are too well known to need recapitulation. In January, when reports were current of a proposed "deal" between the Bell and Drawbaugh interests, the price of Bell stock was about 200. Then, as the year and the hearing of evidence in behalf of Drawbaugh, in Pennsylvania, progressed, the price fell, until in May, at the time of the panic in Wall street, it reached 150. That was the turning point, and it rose gradually until Judge Wallace handed down his decision when it jumped from 195 to 265. Since then it has kept above 250. The Overland Telephone Company in its infringement fight, relied on the Drawbaugh claims, but is now left to find other ground of defence for the Baxter patents. The Clay telephone has been in use extensively in Philadelphia, and its representatives promise to reach out into other territory, while the McDonough telephone is being pushed, and other interests have found foothold in the South. The confirmation of the American Bell Company in its patent rights has been a cause of jubilation to those who operate under them, but the companies seeking to compete affect to regard the clearing away of the Drawbaugh claims as matter of congratulation on their side. In October, the examiners in chief in the Patent Office gave decision in the long-standing interference cases, with the general result of sustaining the priority of invention on the part of Prof. Bell.

At the annual meeting of the American Bell Company, held in February, it was stated in the report that there were 307,010 instruments in the hands of licensees, under rental, being an increase ever the previous year of 57,299. At the present time the number of instruments shows an increase of several thousands and the number of exchanges reaches a round thousand. Extra-territorial lines have been multiplied in every direction, and the whole country is now covered with their network. As might be expected, great attention has been paid to long distance telephony, and a metallic circuit is now in successful operation between New York and Boston. The wire used is hard-drawn copper and answers admirably. Another field attracting attention has been that of telephonic communication between vessels at sea, and the subject was discussed most interestingly at the meeting of the American Association for the Advancement of Science, at Philadelphia, in September.

The tendency toward consolidation has not been less marked than in previous years, and is becoming even more pronounced. One of the most notable consolidations is that of the Law Company with the Metropolitan Company of New York.

The large exchange of the New England Company at 40 Pearl street, Boston, was partially destroyed by fire in January, but the damage was repaired with praiseworthy rapidity, and within five days ordinary communication was reopened.

The sixth annual meeting of the National Telephone Exchange Association was held at Philadelphia on September 16th and 17th, during the International Electrical Exhibition. The attendance was good, Mons. A. Berthon, Chief Electrical Engineer of the Société Générale des Téléphones, of Paris, being among the visitors. Interesting statistics were presented showing that New York had 4,808 subscribers; Brooklyn, 1,846; Philadelphia, 2,199; Chicago, 3,246; Cincinnati, 2,238; St. Louis, 1,362; Baltimore, 1,450; Cleveland, 1,617; Providence, 1,892; Buffalo, 1,420; Albany, 1,142; Detroit, 1,700; Milwaukee, 1,165. A report was also presented giving details with regard to the course of legislation as affecting telephony in 1884. The report was compiled from statements made by members of the Association in all parts of the country, and showed that the tendency was to increase the tax burdens of the companies, at the same time compelling them to increase the expenses of their plant by going underground.

The incubus of litigation having been removed from the American Bell Company by the Drawbaugh decision, the directors of the company at once took steps, in December, to enlarge the sphere of their operations. They voted to petition the Massachusetts legislature for authority to increase their capital from $10,000,000 to $20,000,000, the new stock to be issued at the rate of $1,000,000 per annum. The object of securing this larger capital is said to be the development of long-distance telephony, with which the company experimented all the year.

One prominent object of discussion during the first part of the year was the possibility of ocean telephony. Attention was called to the Gillett apparatus (illustrated and described in this journal on April 19), with which, by means of compound transmitters affording several points of microphonic contact, and by other devices, the problem would, it was hoped, be solved. Talking was carried on with success between New York and Washington, Cleveland and Chicago, but up to the present time the feat of telephoning from New York to Liverpool remains unaccomplished. It is understood that Mr. Francis Blake has recently made a transmitter of great microphonic capacity and mechanical strength, from which great results are expected. But it remains to be seen whether any apparatus can be invented to overcome the difficulties of sub-marine retardation and prolongation.

(TO BE CONTINUED.)

Messenger Boys Defrauded.

The discovery was made last week that the down-town messenger boys were being defrauded of their Christmas boxes by two lads personating messenger boys and attired in the uniform of the Western Union Telegraph Company. The latter collected $500 or $600 that should have gone into the pockets of the regular boys. They were equipped with a poetical circular, which wished their patrons a Merry Christmas and a Happy New Year, and asked them to contribute whatever sum they saw fit—any amount would be thankfully received. This was signed: "W. U. T. and Cable Messengers."

Detectives Williamson and Liston watched scores of messengers on Saturday until they saw two little chaps go into a banking house very cautiously, and come out beaming, and dodge away. They did this at several places, and were arrested late in the afternoon, when ample evidence against them had accumulated. At Police Headquarters the two boys said they were John Bruen, of Steuben street, Brooklyn, and John Cunningham, of Jay street, Brooklyn. They confessed everything except the authorship of the circular. They were formerly Western Union Telegraph messengers, but were discharged in October, and they hit on the scheme to make themselves properly happy at the holiday season. Bruen claims that he collected $300 and Cunningham $220. Their uniforms were lent them by boys yet in the employ of the company, but they pretend not to know their names. The boys visited 76 firms and 11 complaints have been made against them. Among the complainants are W. H. Crossman, No. 77 Broad street; Isaac Belham, No. 5 Pearl street; W. R. Grace, No. 142 Pearl street; H. W. Jones, No. 87 Maiden lane; T. F. Robinson, No. 126 Pearl street; Colgate & Co., No. 287 Pearl street and A. A. Low & Brothers, No. 31 Bowling slip.

Millions of Miles of Wire.—The London *Electrician* prints the cable statistics of the Mackay-Bennett cable inauguration, bringing these to the fore, and puts the length of all submarine cables at sixty-eight odd thousand miles, or nearly three times the circumference of the globe, giving each cable an average of forty wires. The total length used amounts to 25,000,000 miles, ten times the distance between the earth and the moon.

The Thomson-Houston System at the Philadelphia Exhibition.

Although this system is old, and not only has been introduced into manufacture on a large scale, first at New Britain and at present in a substantial, large and new brick building at Lynn, Mass., but also has been installed in many cities and towns in New England, and is gaining reputation throughout the United States—yet there have

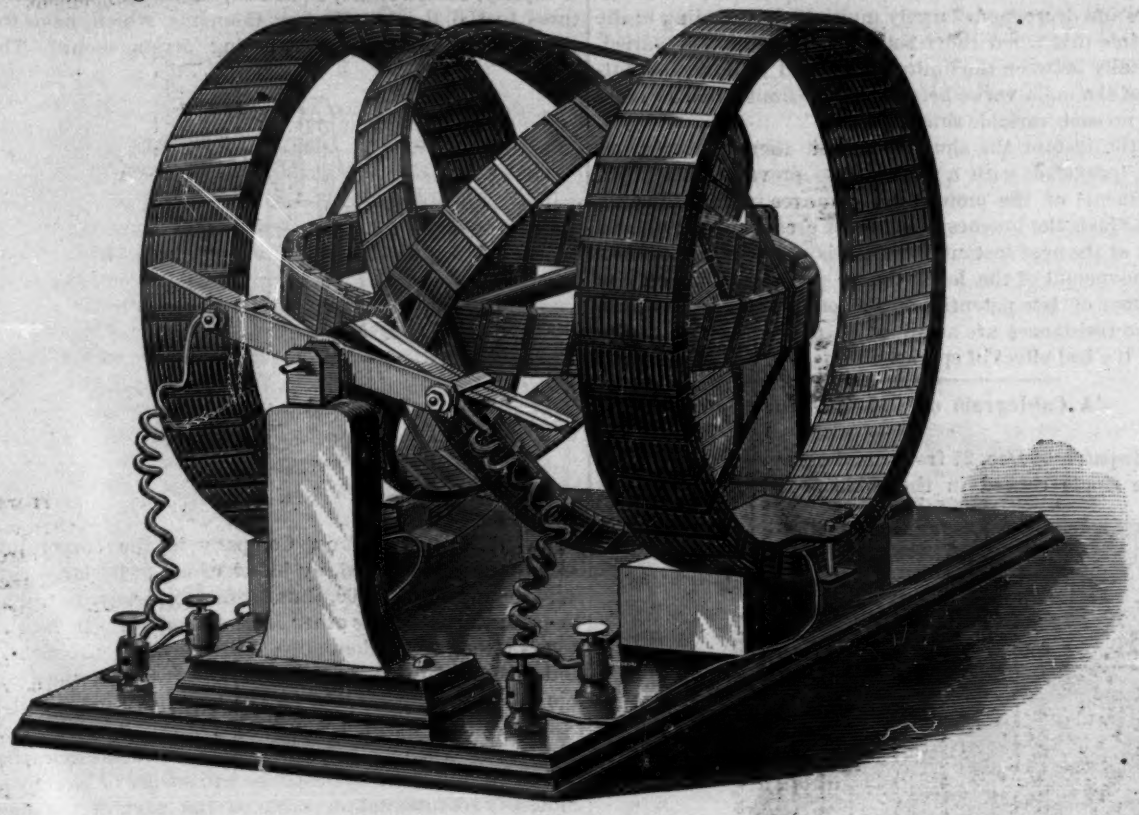


FIG. 1.

been many recent improvements and inventions which were seen at the Philadelphia exhibition, and which this article will describe principally from a scientific point of view.

Some of the companies which use this system of electric lighting are the following: Middlesex Electric Light Co., Lowell, Mass.; Wachusett Electric Light Co., Fitchburg, Mass.; Narragansett Electric Light Co., Providence, R. I.; Hartford Electric Light Co., Hartford, Conn.; Worcester Electric Light Co., Worcester, Mass.; Union Electric Light and Power Co., East Boston, Mass.; Consolidated Electric Light Co., of Maine; Lewiston & Auburn Electric Light Co., Lewiston and Auburn, Me.; Royal Electric Co., of Canada; St. John Electric Light Co., St. John, New Brunswick; the Saratoga Electric Light Co., Saratoga Springs, N. Y.

Under appropriate names companies have also been regularly organized and central lighting stations established at Lynn, Salem, New Bedford, Fall River, Haverhill, Woonsocket, Pawtucket, New Haven, Bridgeport, in New England; at Syracuse, Utica, Auburn, Brooklyn and Binghamton, New York; Springfield and Columbus, Ohio; Quincy and Ottawa, Illinois; Council Bluffs, Muscatine and Des Moines, Iowa; St. Louis and St. Joseph, Missouri; Kansas City and Leavenworth, Kansas; Sacramento, California.

The system is used not only in cities on a large scale, but it is employed by manufacturing establishments for lighting up the factories.

It is found doing good service for the Penobscot Chemical Fibre Co., Barnaby Manufacturing Co., Russell & Erwin Manufacturing Co., Hartford Silk Manufacturing Co., Johnson Manufacturing Co., Buffalo Electric Works, Chaffee Bros., Etiwanda, Cal., Globe Woolen Mills, Litchfield Car and Machine Co., Farist Steel Co., Wind or Locks Steel Co., and in many private wholesale and retail stores, machine shops and hotels.

As the system has become so generally applied in practice, it is interesting to become acquainted with the scientific aspect of the parts which make up the system.

Arc Lamp.—The steadiness of the arc is due more to the action of the automatic regulator of the dynamo than to the mechanism of the lamp itself. An experiment was witnessed by the writer where nine lamps were suddenly switched off and only one was left burning, and yet the regulator worked as it was intended to operate, so that no unsteadiness of the intensity of the light could be observed. It is claimed beyond this experiment that, with a dynamo having a capacity of fifty arc lamps, any number of lamps, one or more at a time, may be switched off or on, and yet those which are left in the circuit will show no unsteadiness. The steadiness, while no lamps are being switched on or off, is, of course, due to the mechanism for adjusting the distance between the carbon electrodes. This mechanism is shown in the accompanying cut (Fig. 5) and diagram (Fig. 2) of the lamps.

The general outside appearance of the lamp is not illustrated.

The mechanism is seen to consist of a lower and upper set of electro-magnets, fastened to the rigid frame on the left and situated near armatures connected to levers on the right. The upper magnets are wound with fine wire in a shunt to the main circuit, and are wound to a standard resistance. The lower set of electro-magnets is of low resistance, being in the main circuit. The clutch consists of a combination of levers, cams and springs, as shown, so combined that when the upper limb of the armature is attracted, the carbon falls, and when the lower limb is attracted by the lower magnets, the carbon is retained in a fixed position. The springs serve to insure the slow and gradual but effective feeding of the carbons by preventing a too abrupt motion and acquisition of momentum. When springs are not used, the motion is sometimes modified by the employment of dash-pots, counterbalancing weights, etc.; but in this lamp, parts are so designed that springs are made to take the place of dash-pots. The operation is that, when the arc has been once established, the carbons gradually consume and the distance between the carbon electrodes becomes greater and greater, so that the resistance of the main circuit also increases. Consequently the current in the magnets *D* becomes less, while that in magnets *S* becomes greater than at the instant previous.

The lever compound armature therefore turns to the position shown in the diagram of the lamp, and the carbon falls with a gradual motion until the currents in the two magnets become of the same proportion as at first, and the carbons resume their proper relative positions.

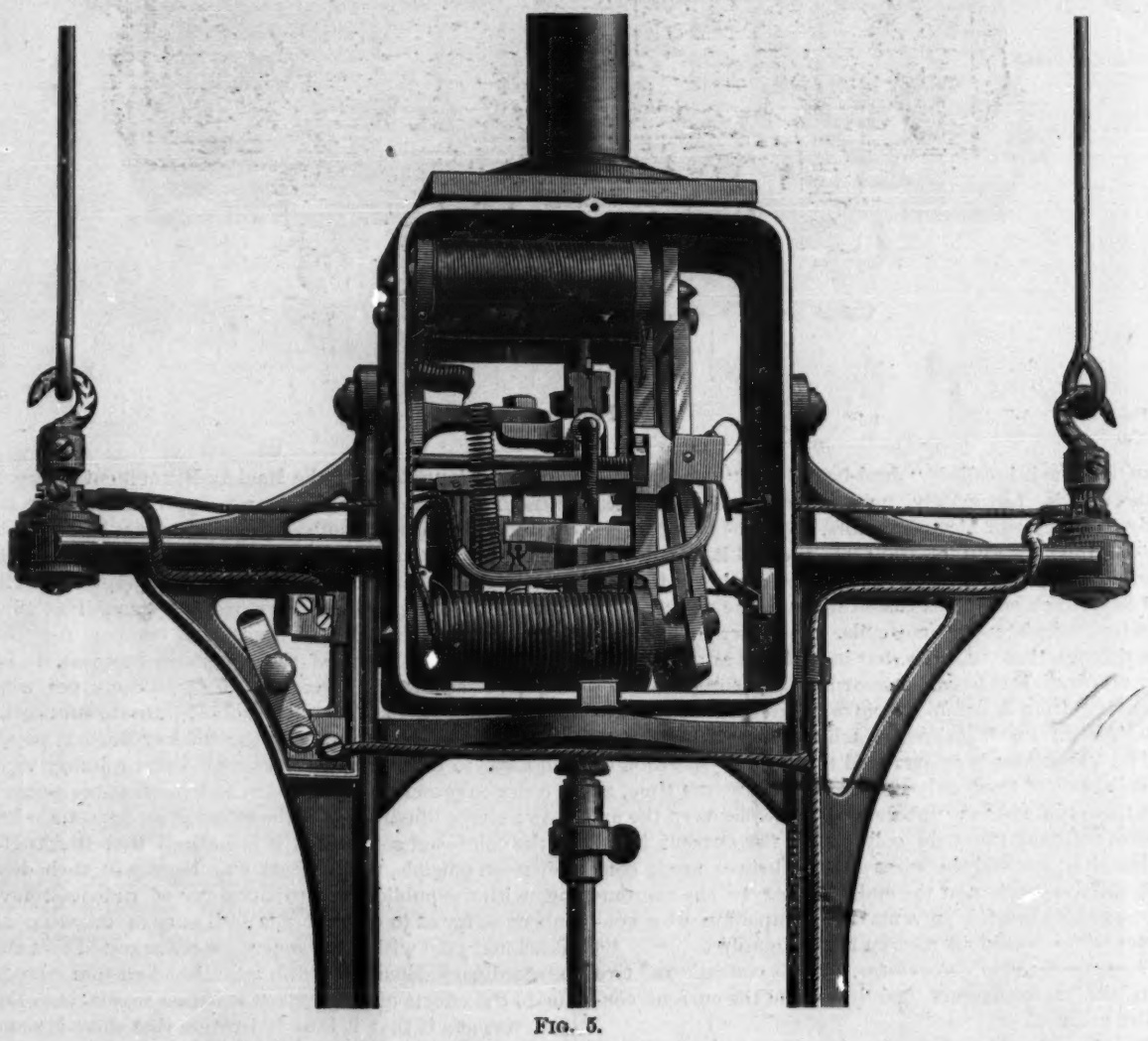


FIG. 5.

The carbon-holder is grooved or scored in such a manner that when the carbon has been consumed to a certain limit, the clutch no longer retains the carbon-holder, and consequently the current is automatically switched from the lamp entirely.

This lamp may truly be said to be free from clock-work, and from all forms of dash-pots.

The renewal of the carbons is made without removing the globe.

There are advantages connected with this system, but, as this is intended to treat principally of the scientific side of the subject, it is trusted that the advantages will exhibit themselves without especial attention being called to them.

Incandescent Lamp.—The Stanley and Thompson lamp, manufactured by the Union Switch and Signal Co., is at present used in the system in connection with the arc lamps; the regulator and distributor described below, allowing the current to be so sub-dividded as to feed uniformly both classes of lamps. The company intend soon to introduce into their system the Thomson-Houston lamp, the description of which is not yet made generally public.

The Thomson-Rice Distributor.—This is shown in the cuts in inside view (Fig. 3) and in part in diagram (Fig. 4).

The object of the distributor is to permit the running of both arc and incandescent lamps from the same dynamo.

It consists, essentially, of a box or iron case containing a set of resistance coils and magnets, the coils being made of German silver wire and wound upon copper tubes, so as to reduce the destructive effects of sparking. The tubes are connected to ground, and thus any induced current is immediately conducted to earth.

The series of these coils *R* are situated just above a series of electromagnets *m*. Each one of these magnets is in circuit with an incandescent lamp or with a series of incandescent lamps, which, on account of the current passing through them cause also a current to pass through the magnets *m* so long as the filaments do not break or the lamp is not switched off either accidentally or intentionally.

When the current is broken, by whatever means, the armature of *m* falls, and automatically switches the current through one or more of the resistance coils *R*, the resistance of which is about the same as the resistance of the lamp. In order to put this distributor to an economical use, of course it is intended to supply a safety device whereby the accidental breaking of the filament or of the wire leading to the lamp will neither throw all that extra current through the remaining arc and incandescent lamp nor switch them all off. To use it, however, for general purposes does not appear to be sufficiently economical, for the resistance coils consume as much energy as the lamps.

The arc lamp circuit enters by the binding posts *L L*, and may be passed through the instrument by the switch *S*.

The safety switch in the centre of the box closes the circuit which charges the distributor. The incandescent lamp circuits enter by the wires *b b*, etc. The current returns from the incandescent lamps by one large wire, *B*.

The idea of compensating the resistance of an incandescent lamp by the coils of a resistance box is not very new; [but the mechanism for accomplishing this auto-

matically, as described in connection with the cut, is new with Prof. Thomson and his assistant, Mr. Rice.

A diagram is shown to illustrate the method of connecting up the circuit with the magnets. The arrows show the direction in which the current circulates.

Sometimes the current reaches an abnormal electromotive force, so that the lamps become too brilliant and are in danger of breaking.

The distributor serves to supply a means whereby the lamps may be lessened in intensity by taking from them a portion of the electrical energy.

This is accomplished by *D*, which by means of the knob on the right of the distributor, causes the resistance coils to be turned into multiple arc with the incandescent lamps.

Electric Motor.—Among the recent inventions of Profs. Thomson and Houston is the electric motor shown in an accompanying illustration (Fig 1). The armature, as in their motor, is in the general form of a sphere, but the details of construction are different from those of the dynamo armature.

The coils both of the armature and of the field are made entirely of the conducting wire.

The principal part of the invention in this motor is in the method of winding and connecting up. The Brotherhood engine suggested the first conception of the idea of winding the armature. It is a well-known trouble in motors as well as in steam engines that when the driving force is turned on, the motor often will not work until it is started by some outside auxiliary assistance. In

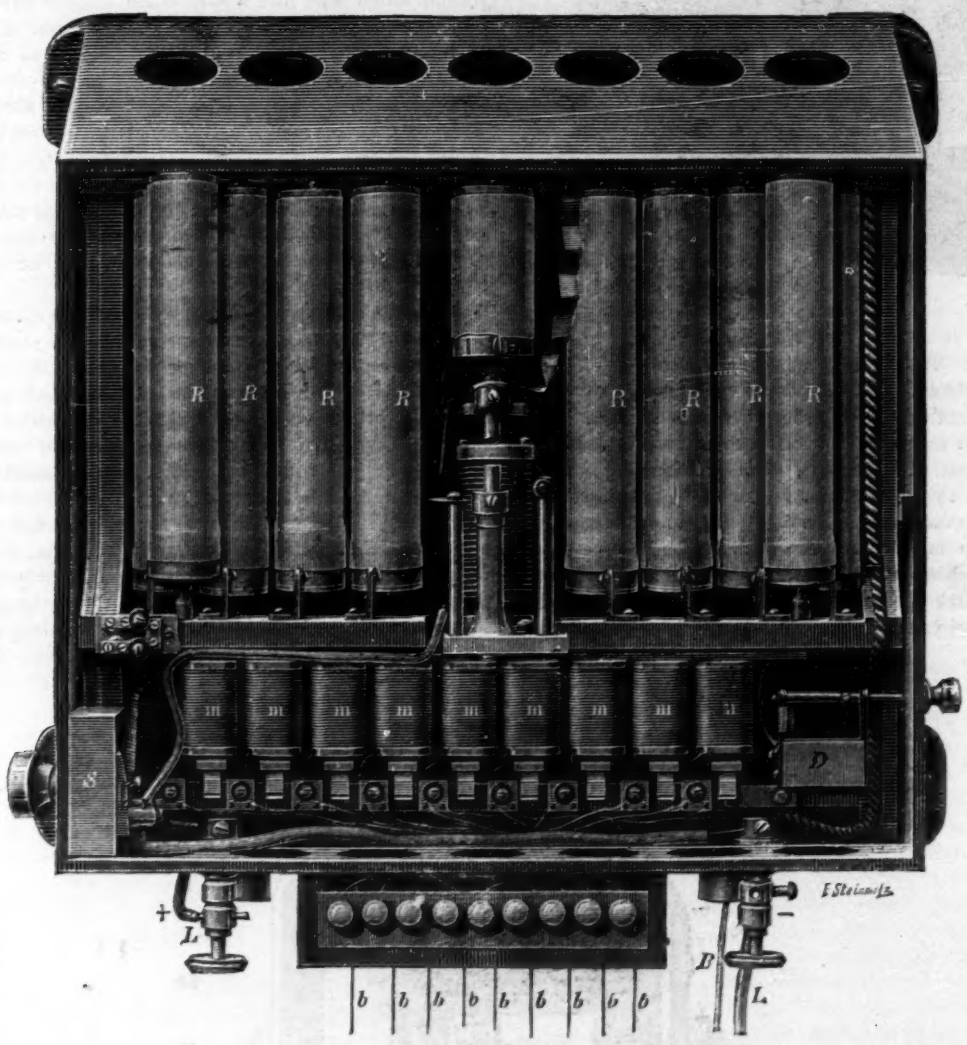


FIG. 3.

steam engines it is called "dead-beat" or "dead-point," while there is, fortunately, no new name yet coined to apply to the case of electric motors.

From the very form of the armature and its method of winding and connecting up it will always begin to turn just as soon as a current is passed through the motor. The armature consists of three coils. The current does not pass through these in series, but in multiple arc, so that it may more properly be called an armature of three branches extending from a common centre than a three-coil armature. The three coils incline to each other at angles of 120°.

The commutator is so arranged that for any position of the coils, two of them only are in multiple arc at a time, so that there is always an unbalanced force between the armature coils and the field coils when the current is on. Although at one end the wires of these helices are in contact, their separation at the ends leading to the commutator and the brushes prevents the completion of a conductor which would short-circuit the armature.

Thomson-Houston Regulator.—This consists of two parts, the motor-magnet and lever and the current controller magnet.

Its action depends upon the principle that when there occurs a fluctuating current due to irregular rotation of the armature, sparking of the brushes, or turning on and off of lamps and other translating devices, it will show its own unsteadiness at contact points arranged between the branches of a shunt of comparatively no resistance. One of the contacts is any portion of the shunt, while the other contact is a solenoid core suspended by a spring. This olenoid is that of the current-controller-magnet (Fig 6), and is arranged in the main line. The spring being adjusted, then where the current fluctuates the spring either is elongated or shortened, so that contact is either made or broken, *i. e.*, the shunt is either closed or opened. If it is closed the resistance is practically nothing, while if it is broken the resistance is infinite.

The spring is so long and sensitive that any unsteadiness of the current will either complete or break the shunt; the consequence follows, therefore, that the current passing through the motor-magnet and lever will have its increments and decrements largely multiplied, according to the principle that when the resistance of a shunt is varied, especially between the limits of zero and infinity, the current of the main varies between wider limits than if there were no such variable shunt.

At the instant the shunt is closed, then the armature lever (provided with a dash pot to prevent too quick a movement) of the motor-magnet moves in one direction and adjusts the brushes to points of greater potential, and when at the next instant the shunt is open, the corresponding movement of the lever causes the brushes to change to points of less potential on the commutator. Suitable carbon resistances are arranged to prevent, as far as possible, the bad effect of sparks.

A Cablegram on Cable Competition.

A dispatch of Dec. 27 from London says:

The ripple caused in the cable pool by the evidently successful launching of the Mackay-Bennett enterprise on Christmas Eve is assuming larger proportions, and the old combination has undoubtedly been aroused from the lethargy which has for the past two years possessed it. John Pender, the leading spirit of this combination, will, now that the opposition have proved themselves thoroughly in earnest, and in a position to compete for their share, or perhaps more, of the American business, do his utmost to secure the present rate of 40 cents per word from further attack. His old tactics, hitherto successful, may again come into play, and the Mackay-Bennett people will have to defend themselves with extraordinary vigor in order to preserve their present independent position.

As a slight illustration of the effect of an opposition line on the combined companies, it is noticed that the Anglo-American officials, usually curt and laconic in their dealings with the public, even to the verge of rudeness, have unbent so far as to commit the indignity of cracking an occasional joke with a customer. It is suggested that this extraordinary departure from established custom may be due to the effects of the festive Christmas season, but close observers assert that it is an indication that there is something behind, possibly a knowledge that negotiations looking to the addition of another member to the fold have already begun. All the companies thus far have strictly adhered to the new rate, and there are no present indications of further cutting. At the offices of the American Cable Company (the Gould cables) all is gloomy and deserted. While the London management ardently desire an opportunity to enter the lists in the present competition, little hope is expressed of an early renewal of communication through their lines, and it is feared that some months may elapse before the broken Gould cables are repaired. The Mackay-Bennett managers are highly elated at their present outlook. It is reasonably certain that they have already secured a good cash business from private firms, and the indications are that the newspapers on both sides of the Atlantic will give their service a fair trial.

The sharp decline in Anglo-American shares to-day has given rise to the report that the Globe Telegraph & Trust Company, John Pender, Chairman, has already made overtures to the Bennett-Mackay Company which have for their object an amicable working arrangement. The

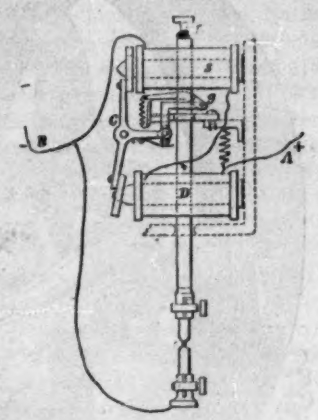


FIG. 2.

Globe Telegraph & Trust Company is the corporation which has been enabled, by judicious use of its large capital of about £15,000,000, thus far to completely control all the Atlantic as well as other cable companies. In face of a very strong opposition, ably headed by Mr. Labouchere and other prominent stockholders, it succeeded some years ago in obtaining control of the stock of the Direct United States Company, which was at once forced into the pool, and there is a general belief in London business circles that the potent influence of the Globe will sooner or later overcome any sentimental objection on the part of the new company to enter the so-called Anglo-American pool.

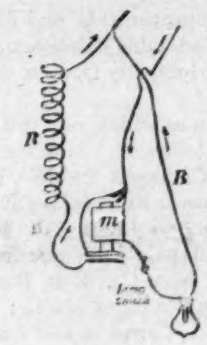


FIG. 4.

Should an amicable arrangement be reached on the basis of past similar combinations, Anglo shares would be depreciated to the extent of about 20 per cent., and to-day's fall is regarded as an indication that negotiations have certainly begun.

The Brush Light and Judge Biddle.

In Philadelphia, on Saturday, Dec. 27, Judge Biddle, in Court of Common Pleas No. 1, delivered an opinion in the suit of the Electric Lighting Company against the Underground Electric Light and Power Company. The Light-

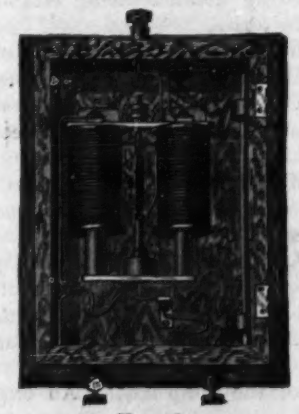


FIG. 6.

ing Company, which is the corporation furnishing what is known as the "Brush light," sought to enjoin the operation of the Underground Light and Power Company on the ground that by the fourth section of the plaintiff's act of incorporation they have the exclusive right to supply electric light to this city until they have for five years declared dividends equal to 8 per cent. on their capital stock. The court rules that the complainants' right to enjoy their franchises and privileges becomes exclusive in Philadelphia only when they have received the permission of the corporate authorities to erect their works, and that, the complainants having failed to satisfy the court that they have received the lawful consent of the authorities to erect their works in the city, the demurrer entered by the defendants in this case is sustained.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LI.—No. 17. [NEW SERIES.] NEW YORK, OCTOBER 25, 1884. [$3.20 per Annum. [POSTAGE PREPAID.]

THE THOMSON-HOUSTON EXHIBIT AT THE INTERNATIONAL ELECTRICAL EXPOSITION, PHILADELPHIA.

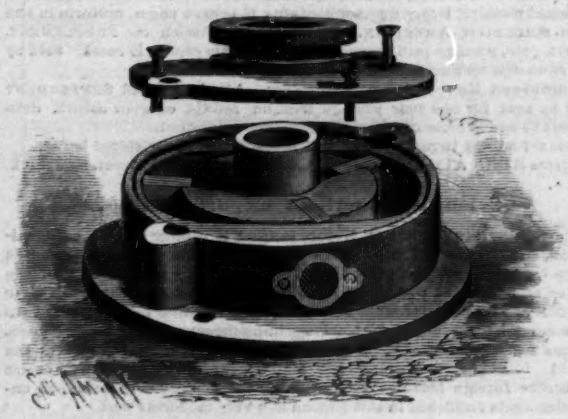
Visitors to the Exposition, upon entering the main gate and then turning to the right, had their attention attracted, before they had proceeded far, by a multitude of powerful arc lights suspended above a raised and richly carpeted flooring. Here were displayed a series of finely wrought mechanisms, from an exposed core of a dynamo to the perfected machine. This was the headquarters of the Thomson-Houston Electric Company, of Boston, Mass., which of late has become widely known for the efficiency of its apparatus and the business-like thoroughness of its system.

In the general exhibit this company had five dynamo machines in constant action, two having a capacity of 30 arc lamps, two more of 12 lights capacity, and still another of 6 lights. Besides these there were models of the unfinished Thomson-Houston dynamo, so arranged that the parts could be inspected, and other specimens of the latest improved type.

To those who had the time and inclination to attentively study this exhibit—and there were many such—conclusive evidence was presented of its possession of novel and striking features when compared to other systems of the same type. It was noticed that the hissing and sputtering, so common in some arc systems, were here reduced to a minimum, and the lights were powerful, constant, and steady.

A diminutive dynamo and plant designed by Prof. Thomson illustrated the system in all its workings far better than could have been done by a plant distributed to distant parts of the building. It showed clearly the relations between current, electromotive force, and work. A small dynamo generated a constant current, which kept aglow six arc lights, each of the intensity of sixty candles, and by switching the current it could be made to leave the arc lights and supply the requisite energy for an incandescent plant.

The peculiarity of the Thomson-Houston dynamo may be said to lie mainly in the armature, the construction of which is strikingly original. This armature is made of a cast iron hollow shell; and iron wires, forming an oblate



spheroid, surround this. Insulated copper wire in three series is wound on this core. Starting at that part of the shaft opposite the commutator, the wire of each of these series is led over the longitudinal circumference of the core, and, in order to avoid the shaft, changes its course and returns *via* the opposite circumference of the core. After making a sufficient number of convolutions, the terminal is carried out to a segment of the commutator, the beginning of the wire being attached to a coupler near that portion of the shaft which is opposite the commutator.

A like direction is taken by the second series of wires, which are kept at an angle of sixty degrees with the first, and the third series of wires follows at another angle of sixty degrees. The initial ends of these last two series are affixed to the coupler to which the first is attached. Hence all of them are electrically connected. To different plates of the commutator the three free ends are affixed. This method of winding has proved to be very efficient, two series being constantly maintained in the field of force.

By means of a combined motor and generator shown in the exhibit, the arc light or motor circuit can be made to feed incandescent lamps, an alternating current being used. The system employed is that of building on the same shaft the armatures for both the motor and the lighting apparatus, and any kind of current as to character or potential may be taken off.

What attracted not a little attention to this exhibit was the running of arc lights in multiple series. This is an invention of Professor Thomson, and a very important one, for, as seen at the Exposition, it permits the running of arc lights of altogether different intensities from a single circuit, some of them being in series, while others are in multiple arc or in multiple series, and renders practicable divisions and redivisions of lights as well as the rejoining of arc circuits.

For the benefit of scientific institutions and the lecture room generally, the Thomson-Houston Company make a hand dynamo. As exhibited, it showed that it is capable of generating a small arc light or several incandescent lights,

THE THOMSON-HOUSTON EXHIBIT AT THE INTERNATIONAL ELECTRICAL EXHIBITION, PHILADELPHIA.

or providing a strong and constant current for other purposes of illustration or experiment, at times showing nearly a one horse power energy.

The motors displayed by this company showed themselves particularly adapted for the transmission of power from a distance, which from present appearances would seem to be one of the great problems of the future.

Perhaps the most important feature of the Thomson-Houston exhibit was the little mechanism inclosed in a small box by which the electric current can be transferred from arc lights, and made to feed incandescent lights of from twelve to sixteen candle power. It is called the Thomson-Rice incandescent distributor. Heretofore little has been done in this direction; either arc or incandescent lights being exclusively distributed, because it was found that the cracking of one or more incandescent lamps usually led to the breaking of many more in the same group. By the device exhibited, however, an arc light can be turned out, and a group of eight incandescent lights be made to glow instead. Furthermore, all the lamps or any particular number of these in one circuit can be turned on or off with the same facility as gas jets can be operated, and without danger to other lights in the circuit. The little mechanism acts automatically and electrically, and is at no time subject to accident by reason of careless handling. As a whole, the Thomson-Houston system shows, as exhibited, that it is founded upon a correct interpretation of natural laws, and that its workings are directed by men who are conversant with the theory as well as the practice of electrical engineering.

The National Academy of Sciences.

A session of this society was held at Newport, R. I., Oct. 14 to 18. The National Academy was incorporated by Congress in 1863, to "consist of not more than fifty ordinary members," and the custom has been that these shall be selected specialists such as will best represent every department of knowledge. We believe there are now about one hundred members of the Academy, but it is nevertheless a very select organization as compared with that much larger body, the American Association for the Advancement of Science, and manypapers read at its meetings are such as would be of little interest to other than specialists in the subjects treated of.

Among the papers read was one by Prof. E. D. Cope to show the evolution of certain bones of the ear in *Pelicosauria*, involving a study in comparative anatomy as well as evolution.

Prof. Fairman Rogers, of the University of Pennsylvania, described experiments on the motion of animals, as depicted by instantaneous photography. In some experiments conducted last summer at Fairmount Park, Philadelphia, forty cameras were placed in a row, and so adjusted as to be successively opened by the motion of an animal passing in front of them. These experiments will throw light on the mechanism of animals, and, it is suggested, may give valuable application in machinery. For instance, marine engineers do not agree on the best form of steamer screws, and it is intimated that an exhaustive study of the fish's propeller would throw light on this. There will probably be no difficulty in arranging a glass tank through which fish can be made to swim, and be photographed in transit. The motion of dogs, horses—especially racers—deers, and other animals, in running, were described; and interesting and prolonged discussion ensued. Professor Rogers stated an interesting point to be the flexure of the long pastern. When a horse gallops, he moves in a horizontal line. His body keeps almost a uniform direction, notwithstanding that his feet rise and fall. He bends his pastern to keep level. In race horses it touches the track. He cited as an instance a celebrated race horse, which used to make eight marks on the ground, four for the pasterns as well as the four foot tracks.

Professor Tylor, of Oxford, England, the eminent anthropologist, considered at great length the "Civilization of the American Races," particularly the Zuni, Navajo, Mojave, and Wallopi tribes, among which he had traveled.

Among those present at this meeting of the Academy were President O. C. Marsh, Professor of Paleontology of Yale; Home Secretary Asaph Hall, Astronomer of the National Observatory; Treasurer J. H. C. Coffin, United States Navy; W. H. Brewer, Professor of Agriculture, Yale; G. J. Brush, Professor of Metallurgy, Yale; Josiah P. Cooke, Professor of Mineralogy, Harvard; Edward S. Dana, Professor of Physics at Yale; Walcott Gibbs, Professor of Chemistry at Harvard; Julius Hilgard, Superintendent of the Coast Survey; Samuel P. Langley, astronomer in charge of the Allegheny Observatory; J. S. Packard, Professor of Zoology at Brown University; Edward C. Pickering, director of the United States Geological Survey; Samuel H. Scudder, editor of *Science*, of Cambridge Mass.; William P. Trowbridge, Professor of Mechanics at Columbia College; and Francis A. Walker, President of the Massachusetts Institute of Technology.

A New Pavement in Berlin.

A new form of paving has been in use in Berlin since last year. Layers of bricks are put down impregnated with asphalt. After a time they absorb from 15 to 20 per cent of the bituminous matter, becoming remarkably elastic and capable of resisting pressure and damp. This new paving, it is said, lasts much longer than any of the other kinds, and it offers a sure foothold to horses. It is a very popular pavement in the capital of Prussia.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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A PRIZE FOR INVENTORS.—NEED OF PASSENGER AND FREIGHT CAR BRAKES.

Railroad officials seem to have arrived at the settled conviction that no essential improvements can be made in passenger car brakes; that the air or vacuum brakes, with all their faults and deficiencies, are as nearly perfect as can be, and that it is useless to seek further. And as practically all the roads have adopted these brakes for their passenger traffic, they naturally oppose the introduction of any improvements that would depreciate their costly investments.

For the present, then, the passenger car brake question may be considered settled, but it is not so with the freight car brake.

It may be asked why the air or vacuum brake is not as well adapted to freight traffic as to passenger traffic. In reply the roads say that the cost of the air or vacuum brake is greater than the freight service will bear; that the air or vacuum brake must, to be effective, be continuous, or connected for all the cars in a train; that this necessary continuity or connection of all the brakes in a train can, without much trouble, be assured in passenger traffic, wherein the interchange and mixing of cars rarely occurs, but that the conditions obtaining in freight traffic are such that each car must be equipped with a brake that will act independently of any other in the train.

On all the principal lines of railroads the majority of the freight trains are partly made up of "wild" cars (cars from other roads) and these cars are necessarily distributed throughout the train in the order of their arrival, so that one "wild" car without the air or vacuum brake in a train equipped with the air or vacuum brake might render all the brakes on the train ineffective.

Another objection which the roads make to the air or vacuum brakes for freight traffic is that the brake nose connections deteriorate from exposure, and that the couplings offer irresistible temptation to thieves.

If in spite of special care and watch in the yards the nose connections often give out and the brass couplings are almost daily stolen, what, they say, would become of the brake on freight cars which are run off and held on sidings all along the road for days and weeks, waiting to be loaded or unloaded?

There are other minor objections to the air or vacuum brake for freight traffic, but these mentioned appear to be inseparable from this class of brakes.

Not only, then, are the lists open to a suitable freight brake, but the roads are united in seeking for it.

This is one of the broadest fields for inventors, and will yield most abundant reward to the successful ones.

Great fortunes have been made from the air or vacuum passenger car brakes, and yet the whole number of passenger cars in this country are less than one-thirtieth of the number of freight and coal cars, which are all in want of their special brake.

Freight trains are still operated by the common hand brake, and though many other kinds have been proposed, the roads prefer to hold to their old friend until something in all respects superior shall be produced.

It is true that the hand brake requires a crew of two or three brakemen to a train, while a suitable brake would require no brakemen; it is true that it cannot quickly control a train running at high speed, and consequently that for safety the trains must be run slowly; and it is true that its persistent use daily brings death or injury to one or more poor railroad employes; but nothing yet devised for the purpose possesses all its virtues and fewer faults and is, at the same time, cheap enough.

For the benefit of inventors we have given this brake problem long and careful study, in which we have been aided by a number of prominent experts in railroad matters.

We can say, then, that a brake which shall fulfill all the requirements of freight train service must be cheap, simple, and durable, and require no special skill to repair or keep it in order, and it must possess the following functions and advantages:

1. It must be thoroughly automatic, and entirely under the control of the engineer.

2. It must adjust itself automatically, to suit either direction in which the car is pulled.

3. It must operate at any and all rates of speed.

4. It must be complete in itself on the car to which it is attached, and independent of the action of other brakes in the train, so that "wild" cars will not interfere with its action.

5. It must be capable of bringing a train to a "full stop," and, if on a descending grade, of "holding it."

6. It must admit of a train being moved a short distance at slow speed, and yet be operative to stop it again.

7. It must not interfere with the backing of a train, nor in any way with the handling of a train in yards.

8. It must provide for the stopping of the rear portion of a train when broken loose.

9. It must never cause sliding of the wheels.

10. It must never interfere with the use of the hand brake staff.

11. It must be easily rendered inoperative.

12. It must operate with slight motion of the drawbar, and not be injuriously affected by excessive motion thereof.

It should be applied in place without removing car truck or axle.

And finally, it should be so constructed that but one truck on a car need be equipped with it.

Overhead Telegraph Wire.—IV.

BY WM. MAVER, JR.

The tests for conductivity are next made.

In its natural state and in the course of smelting iron frequently becomes mixed with carbon, sulphur, phosphorus, etc., which impurities it is the object of the different smelting and hammering processes to remove, but not always successfully. Iron and copper being much better conductors of electricity than the above named substances, it occasionally happens that a batch of wire is turned out whose conductivity is much below the standard required. In addition to this, copper being a comparatively soft metal, alloys are occasionally resorted to for the pur-

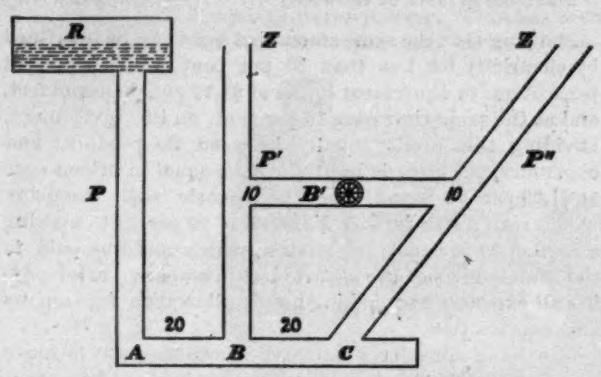


FIG. 6.

pose of imparting strength to it, at the expense, however, of electrical conductivity. To detect any such impure or alloyed wire electrical tests are made.

For this purpose, a sample, either one-fiftieth or one-hundredth of a mile, is customarily chosen, and the method of testing generally adopted is that known as the Wheatstone bridge method.

The principle of the Wheatstone bridge is somewhat difficult of comprehension, but its capabilities and usefulness are so forcibly and prettily brought out in these tests that I shall enter at some length into an explanation of it.

I am the more disposed to do so from the fact that, on several occasions, I discovered that the intelligent gentlemen who made the factory tests were quite ignorant of the principle on which the measurements were based and were very eager to get an insight of it.

By this statement I do not, in the slightest manner, wish to cast reflections on the correctness of the electrical tests obtained by these gentlemen, for it is one of the beauties of the system that when properly set up it gives its measurements nearly mechanically.

From experience, however, I apprehend that a simple electrical explanation of the Wheatstone bridge will not be entirely sufficient to those who have not studied the question somewhat thoroughly, so I shall, by way of preparation, resort to an illustration which I have often found useful when endeavoring to give oral explanation of this subject, before proceeding with the technical description.

In Fig. 6 *R* is a reservoir of water at a height of, say, 20 feet above the lower ends of the pipes *P*, *P'* and *P''*, which are connected together as seen.

The pipe *P* is in communication with the reservoir, and consequently there is a pressure at *B* and *C* of 20 feet. Let us call it a potential energy or power to do work of 20. We are all aware that as the water rises nearer to its level the pressure will decrease, and will cease altogether when its level is reached.

P' rises parallel with *P*, while *P''* is an inclined pipe which reaches the same height as *P'* and *P*. Now when the water has risen to the point in either pipe where the pressure has fallen to 10 as in the figure, we know that it has risen half way to its level, and

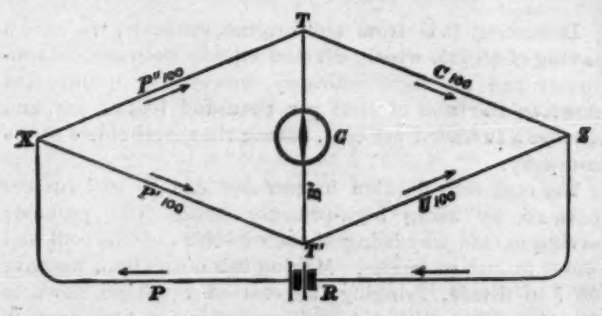


FIG. 7.

when we find *that* point in both the pipes, *P'* and *P''*, it is easy to see that a pipe *B'*, leading from *P''* to *P'* at those points, will not convey a current, as the pressure, or power to do work, is equal at those points in each pipe, notwithstanding that, owing to the inclination of *P''* the distance from *C* to *B'* in *P''*, may be many times greater than between *B* and *B'* in pipe *P*. It is easy also to see that if the connecting pipe *B'* should be placed at a higher level in *P'* than in *P''*, or vice versa, a current of water would then flow through *B'*,

We will now have inserted a water-wheel in *B'*, which will indicate the passage of a current through that pipe. We will further suppose that we have easy access to *P''*, and that the connecting pipe *B'* is under our control as to its position in ether pipe. If now we should wish to find a point in *P''* where the pressure is equal to any stated point in *P'*, we can do so by moving *B'* along *P''* until the wheel in *B'* ceases to move.

It is, of course, understood in this illustration that the pipes *P'* and *P''* are supposed to have an outlet slightly lowerthan the level of the reservoir in order to have a flow of water.

The reader, for purpose of illustration, may consider that the fall of potential in the branches of the Wheatstone bridge, about to be described, is analogous to the fall of pressure of the water, and that the object of changing the resistances in the branches or pipes of the Wheatstone bridge is to, as it were, bring the bridge to that point where the pressure is equal at both of its ends.

The instruments necessary for the operation of the Wheatstone bridge tests are a galvanometer, preferably a Thomson's reflecting galvanometer, a rheostat and a small battery.

These instruments are arranged theoretically, as shown in Fig. 7, in which *R* is a battery, *G* the galvanometer, in the route *B'* (which may correspond to *B'* in Fig. 6), which is the bridge proper. The wires *P'* and *P''* are arms of the bridge. *C* is an adjustable rheostat, and *U* is a substance, the unknown resistance of which is to be ascertained.

It is a law of electricity that when the potential at each end of a circuit is equal there will be no current through that circuit. Therefore, when, in Fig. 7, the potential is made equal at *T* and *T'*, by any means, there will be no flows through that circuit, and consequently the needle of the galvanometer will remain at rest.

It is another law of electricity that the fall of potential along a conductor is in direct proportion to the resistance of the conductor, so that, if at the positive pole of battery *R'*, we should find the potential of the battery to be 20, and farther along the circuit we should ascertain that the potential had fallen to 10, we would know that at the latter point the current had traversed one-half of the resistance of the circuit.

Still another law of electricity is that, when a current has a choice of paths, it will divide itself throughout the different routes in proportion to the resistance of the circuits.

Now, referring to Fig. 7, let us say that at the point *X* the potential is 20, and at the point *Z* it has fallen to zero. As yet we are not supposed to know the resistance of the circuit *U*, but if we arrange our resistances so that in branch *P'* and *P''* there are 100 ohms each, and if we find that by inserting 100 ohms in *C* the galvanometer does not deflect, we must come to the conclusion that the potential at *T* and *T'* has been brought to equality. Therefore, as the total resistance from *X* to *Z*, via *P''* and *C*, is 200 ohms, and as, having made it so, we know the resistance from *X* to *T'* to be 100 *ohms*, there *must* be 100 ohms resistance between *T* and *Z*, otherwise the potential at *T* could not be equal to that at *T*. In other words, the potential having fallen one-half at the points *T* and *T'*, there is, as in the case of the illustration, Fig. 6, an equal "power to do work" at those points, and hence no current in *B'*. When this result is attained the bridge is said to be balanced.

The above arrangement is usually adopted when it is known that the capacity of the rheostat is either small enough or large enough to test the unknown resistance *U*; but in the case of measuring, say, the one hundredth of a mile of No. 14 copper wire, the resistance is perhaps so low that there is not a small enough coil in the rheostat to bring the galvanometer to a balance, the lowest coil being, I shall say, the one-tenth of an ohm. Supposing one mile of the above wire to offer a resistance of 8 ohms, the one-hundredth part of a mile should offer but eight one-hundredth ohms (.08), which is somewhat lower than the smallest coil, so that another expedient has to be availed of as follows:

In branch *P''* we will insert 1000 ohms, in branch *P'* 10 ohms; we then place the $52\frac{8}{10}$ feet of wire in *U* and alter the resistance of *C* until the needle of *G* is balanced; we shall find that it becomes so when we have exactly 8 ohms in *C*. Now in this case we already know that the resistance of the wire in *U* is .08 ohm. So that in the circuits from *P'* to *C* there are 1,000 and 8 ohms, and in *P'* to *U* 10 and .08 ohms.

This makes a marked difference in the two circuits *P' C* and *P' U*, as regards their respective resistances, and it might appear that, inasmuch as the strength of current will be so much greater on the shorter route, viz., *P' U*, than via *P' C*, the needle in *B'* would be deflected, but it is not so, for this is a case where the strength of the current does not come into consideration; it is strictly a matter of potential. In this instance at the point *T* (see Fig. 8) the potential has fallen 1,000 parts of its total height, supposing that for each unit of resistance we assume a degree of potential (which from *X* to *Z* via *P'* and *C*,

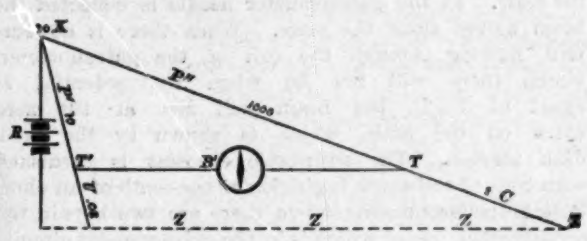


FIG. 8.

would make a total of 1,008 degrees), and at *T'* via *P'* and *U* the potential has fallen through 10 parts of its total height, the total number of parts by this route being 10.08. Now as 1,000 parts out of 1,008 parts, in a total height of 20, is equal to 10 parts out of 10.08 in a similar height of 20, we can readily see that the potential at *T* and *T'* must be equal, as already said.

In Fig. 8 the Wheatstone bridge is shown in another shape to show this fall of potential. If, as stated above, by potential we understand "the power to do work," we may see a line drawn from *T* to *T'* is quite straight, and

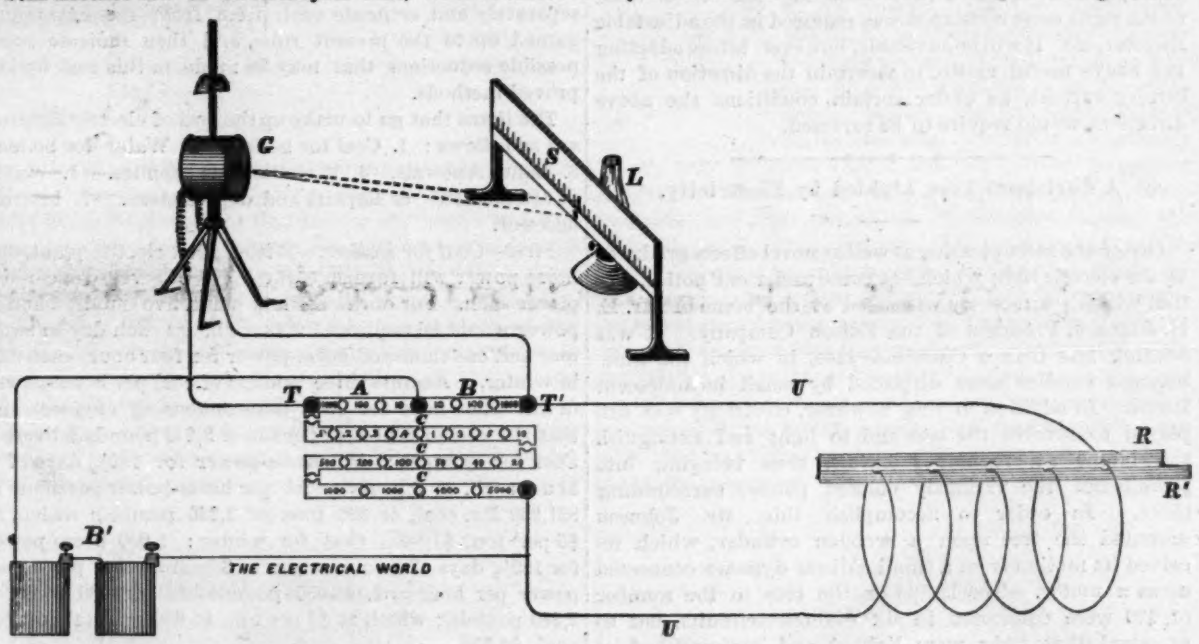


FIG. 9.

that both are at the same distance above zero; thus any pressure, or any tendency of the current to flow through the galvanometer from *T'*, is counteracted by a current of equal pressure from *T*.

Yet we know that the resistance of *U* is less than 8 ohms, which is the amount of resistance in *C*, at which we obtain our balance. In fact, as previously stated, we know the resistance of *U* to be .08 of an ohm, but, in actual practice, we are not supposed to know it, and therefore we must have a means of calculating the actual resistance in the unknown circuit when the arms of the bridge are unequal. Now, in Fig. 8, we see that for every ohm that the current traverses between *X* and *T'*, it traverses 100 between *X* and *T'*, and to obtain a balance at *G*, or, in other words, to make the potential equal at *T* and *T'*, the same ratio must be preserved from *T* to *Z* and *T'* to *Z*. Thus, as between *X* and *T*, and *X* and *T'*, the ratio is 100 to 1, it must necessarily be the same between *T* and *Z*, and *T'* and *Z*, and as the resistance in our rheostat from *T* to *Z* is 8 ohms, consequently the actual resistance of *U* is one-hundreth of 8 ohms, that is .08 ohms.

The beauty of this arrangement of the Wheatstone bridge is well shown in the measurement of the one-hundredth part of a mile of wire, when the ratio in the branches *P P'* of the bridge is 1000 to 10, inasmuch as the resistance obtained in the branch *C*, while in reality one hundred times greater than the resistance of the piece of wire in *U*, is at the same time the actual resistance of *one mile* of the same size of wire. To explain: We will imagine that the result obtained in branch *C* is 8.7 ohms. The resistance of *U* is therefore one-hundredth of this, namely, $\frac{8.7}{100}$ ohms, but as *U* is only the one-hundredth part of a mile we have to multiply $\frac{8.7}{100}$ by 100 $\left(\frac{8.7}{100} \times 100\right)$ to get the resistance for one mile, which, of course, brings the figures back to 8.7 ohms.

Fig. 9 shows the connections frequently used in testing fractions of a mile of wire. In it *A* and *B* are the branches, *C* is the adjustable rheostat, *T* and *T'* the points of equal potential, *U* the unknown resistance (in this case the wire, which is coiled through and through the wooden bracket *R*).

This bracket is made in two parts and hinged at *R'*, so that it may be raised to admit the wire in the notches. This arrangement keeps each coil separate from its neighbor. After the test is completed the entire bracket may be raised up out of the way. Another arrangement for holding the wire while this test is being made consists of a cylinder having a spiral insulated groove in which the wire is rolled. The Thomson galvanometer is so well known that an explanation is almost needless. A slit in the screen *S* admits a ray of light to the mirror of the galvanometer *G*. The mirror reflects the beam back to the scale. As the galvanometer needle is deflected the beam moves along the scale. When there is no current flowing through the coil of the galvanometer, which there will not be when the potential is equal at *T T'*, the beam will rest at the zero mark on the scale, which is shown by the thick dash thereon. The adjustable rheostat is furnished with coils of resistance beginning at one-tenth of an ohm. Besides the instruments shown there are two keys in the arrangement, one of which is in the galvanometer circuit, the other in the battery circuit. The battery key is first depressed, then the galvanometer key.

It is thus easy to see that when this apparatus has been once correctly set up by an expert, it becomes a very simple matter to test the wire, especially when the approximate resistance of the wire is already known ; for in that case the beam will remain at zero after one or two slight alterations of the rheostat.

In one of the factories that I have visited I observed a sign above the rheostat box which read :

To the left, plug in;

To the right, plug out ;

which, of course, meant that when the deflections were to the right more resistance was required in the adjustable rheostat, etc. It will be advisable, however, before adopting the above useful motto, to ascertain the direction of the battery current, as under certain conditions the above directions would require to be reversed.

A Christmas Tree Lighted by Electricity.

One of the most pleasing as well as novel effects produced by the electric light which has come under our notice, was that which we recently witnessed at the home of Mr. E. H. Johnson, President of the Edison Company. It was nothing less than a Christmas tree, in which the time-honored candles were displaced by small incandescent lamps. In addition to this, however, electricity was employed to revolve the tree and to light and extinguish the lamps at regular intervals, thus bringing into prominence the variously colored gauzes surrounding them. In order to accomplish this, Mr. Johnson mounted the tree upon a wooden cylinder, which received its motion from a small Edison dynamo connected up as a motor. The lamps on the tree to the number of 120 were connected in six different circuits, but so arranged that forty were lighted and extinguished at each make and break. The latter operations were effected by several brushes which pressed against a like number of strips of copper situated onthe periphery of the cylinder supporting the tree, in a manner which will be readily understood.

The lamps employed were of three-candle power, and the tree revolved about three times in a minute, thus giving ample time to note the effect of the ever-changing colors.

The motor and cylinder occupied a space of about 18 inches cube, and were inclosed so as to be out of sight and as a safeguard against accidental injury.

The room in which the tree was exhibited contained another application of the electric light to domestic purposes, in the shape of a grate. This latter seemed to be heaped up with glowing coals; it required the closest inspection, however, to discover that such was not the case, and that the effect was produced by a heap of pine shavings, under which two lamps had been placed. The illusion was perfect, and the cheerfulness of the room was not in the least diminished by the exposure of the trick.

We might add that the entire home of Mr. Johnson is lighted by electricity throughout; nearly one hundred 10-candle-power Edison lamps are employed, all being fed by a current from a dynamo situated in the cellar. The power is derived from a small Armington & Sims Automatic Engine, and the capacity of the dynamo is sufficient to light 300 lamps. Although this number is not at present in use, it will soon be, as Mr. Johnson proposes to give some of his neighbors the benefit of his enterprise. There is not the slightest trace of vibration which might be expected from the presence of a steam engine and dynamo, and the entire plant, including boiler, occupies but very small space. Mr. Johnson has set an example that deserves to be followed, and we hope to be able to record in the near future that others have fitted up their homes with the same pleasant light which many of them enjoy at their business offices.

The Economy of the Electric Light.*

That the electric light has many advantages over gas light is admitted, and if it can be shown to be more economical, its use will become universal.

The primary source of the light in both cases is the combustion of carbon, but in the case of gas lighting the carbon is carried to the point where the light is produced and there burned; while with the electric light the carbon is burned in the furnace of a steam boiler and the heat converted into power, used to generate electricity, which, in its passage through a filament fixed at the point where the light is wanted, renders the filament incandescent, producing the light.

What is the relative cost of the two systems. Take for illustration, ten blocks of houses and assume that each block requires twelve hundred (1,200) seventeen candle-power lights; divide the year into two equal parts, or summer and winter, because our severe winter has an important influence on the subject; assume that in summer one-third of the burners are used for three hours every evening, and that in winter two-thirds of the burners are used for four hours every evening.

A good burner using five feet of gas per hour will give a seventeen-candle light. The cost of gas to the consumer is $2.25 per thousand feet in New York.

Cost for summer: 4,000 lights for 182½ days of three hours each, at 5 feet per hour = 10,950,000 feet; which, at $2.25 per thousand, $24,637.50. Cost for winter: 8,000 lights for 182½ days of four hours each, at 5 feet per hour = 29,200,000 feet; which, at $2.25 per thousand, $65,700. Total for year, $90,337.50.

This will represent the total cost to the consumer of the gas illumination, including interest, depreciation, repairs, attendance, etc., all expenses being included in the price of gas.

The cost of the electric illumination will not be so easily determined, because this system is not so fully developed as the other. We will therefore take the items of the cost separately and estimate each item from the experience gained up to the present time, and then indicate some possible reductions that may be made in this cost by improved methods.

The items that go to make up the cost of electric lighting are as follows: 1. Coal for boilers. 2. Water for boilers. 3. Lamp renewals. 4. Miscellaneous supplies. 1. Wages of attendants. 6. Repairs and depreciation. 7. Interest account.

First—Coal for Boilers.—With a good electric plant, one horse-power will furnish eight lights of seventeen candle-power each. For our imaginary plant, five hundred horse-power would be required for three hours each day in summer and one thousand horse-power for four hours each day in winter. Assume three pounds of coal per horse-power (a fair allowance for good non-condensing engines) and that the cost of coal is $5 per ton of 2,240 pounds delivered. Cost for summer: 500 horse-power for 182½ days of 3 hours each, at 3 pounds coal per horse-power per hour = 821,250 lbs. coal, or 366 tons (of 2,240 pounds); which, at $5 per ton, $1,830. Cost for winter: 1,000 horse-power for 182½ days of 4 hours each, at 3 pounds coal per horse-power per hour = 2,190,000 pounds coal, or 960 tons (of 2,240 pounds); which at $5 per ton, $4,900. Total cost for coal, $6,750.

Second—Water for the Boilers.—A fair allowance of water is 27 pounds per horse-power per hour. The price in New York is 13½ cents per thousand gallons. Water for summer: 273,750 horse-power hours, at 27 pounds per horse-power = approximately, 923,900 gallons; which, at 13½ cents per thousand, $124.50. Water for winter: 730,000 horse-power hours, at 27 pounds per horse-power = approximately, 2,463,750 gallons, which, at 13½ cents per thousand, $332.50. Total cost of water, $457.

Third—Lamp Renewals.—It is safe to estimate the life of the carbon filaments at 600 hours, and that the cost of each renewal will be 90 cents. Summer: 4,000 lamps for 182½ days of 3 hours each = 2,190,000 lamp hours. Winter: 8,000 lamps for 182½ days of 4 hours each = 5,840,000 lamp hours. Total, 8,030,000 lamp hours, which, divided by 600, gives 13,383 lamp renewals, at 90 cents each, $12,044.70.

Fourth—The Miscellaneous Supplies will cost about $300 for the summer and $450 for the winter = $750 a year.

Fifth—Wages of Attendants.—As the plant is in operation less than half of a working day, the repairs to wires, lamps, etc., can be made by the engineer, and the coal can be trimmed by the fireman when the plant is not in operation. This being the case, one engineer and one fireman will be all that is necessary in summer, and one additional fireman will be required in winter. Allowing $4 per day engineer and $2.50 per day for fireman, we have: For summer, 182½ days, at $6.50 = $1,186 ; for winter, 182½ days, at $9 = $1,642.50. Total cost of attendants, $2,828.50.

Sixth and Seventh.—In order to arrive at the proper charge for depreciation and interest, let us estimate the cost of the plant. Cost of ground and building, $15,000; engines and boilers, $50,000 ; dynamos, $40,000. Total, $105,000. Wires and fixtures would not cost any more than gas pipes and the usual gas fixtures. Allowing 10 per cent. on the above amount for repairs and depreciation, the charge to that account will be $10,500. A similar charge should be made for interest.

RECAPITULATION.

First—Coal for boilers	$6,750.00
Second—Water for boilers	457.00
Third—Lamp renewals	12,044.70
Fourth—Miscellaneous supplies	750.00
Fifth—Wages of attendants	2,828.50
Sixth—Repairs and depreciation of plant	10,500.00
Seventh—Interest account	10,500.00
	$43,830.20
Cost of gas illumination	$90,337.50
Cost of electric illumination	43,830.20
Difference in favor of electricity	$46,507.30

Showing that the same amount of light can be furnished by electricity for less than 50 per cent. of the present price of gas or equivalent to gas at $1.12 per thousand feet, and at the same time earn 10 per cent. on the investment, Dividing this profit equally between the producer and consumer, the electric light would be equal in price to gas at $1.69 per thousand, and the electric light company would earn a still further dividend of 20 per cent., making a total of 30 per cent. per annum, which could be paid to the shareholders of the electric light company, after paying all expenses and making ample allowance for repairs and depreciation.

Now let us consider what further economy may be made in electric lighting. Our severe winter has an important influence, and it is this influence which I now propose to consider. Engineers who have studied steam know that with our engines only a small fraction of the theoretical economy is realized by the best of them. One pound of ordinary coal develops 12,000 units of heat, which represent 12,000 × 772 (Joule's equivalent) = 9,264,000 foot pounds or units of force, which is less than one-quarter pound of coal per horse-power per hour, and, as we have allowed three pounds of coal per horse-power per hour, it is evident that the engine only gives back in work one-twelfth of the heat furnished to it, the other eleven-twelfths being rejected and sent out of the exhaust pipe. The combination of the electric light with the heating apparatus in our cold winters furnishes the basis for a perfect utilization of all the heat in the coal. Instead of burning the coal for heating in separate hot air or other warming apparatus in each house, let us burn it at our electric light station, dispensing at the same time with the dirt and trouble connected with having a furnace in each house. We will convert the heat of the coal into high pressure steam. First, passing this steam through an economical steam engine, converting all we can of it into mechanical work, using this part for lighting the buildings, and instead of wasting the greater part of it by sending it out through the exhaust pipe, all the heat rejected by the engines will be employed usefully by sending it into the heating apparatus of the buildings, where it will be condensed and returned to the boilers as water to be re-evaporated. In this way the same coal (with a very slight addition, if any) will both light and warm the buildings. The effect of this will be that during the winter only about one-twelfth of the coal burned, the water used, the wages of firemen and of the repairs, depreciation and interest on boilers will be chargeable to the lighting. Revising our estimates accordingly, the account will stand as follows :

Coal for boilers	$2,350.00
Water for boilers	154.00
Lamp renewals	12,044.70
Miscellaneous supplies	750.00
Wages of attendants	2,007.00
Repairs and depreciation of plant	9,000.00
Interest account	9,000.00
Total	$35,305.70

Deducting this from our original estimate, we have a saving of $8,525, which, divided equally between the consumer and the light company, brings the illumination down to the basis of $1.48 per thousand feet of gas, and divides a further 7 per cent. among the shareholders of the company.

The coal consumption in summer can be still further reduced by using high-pressure steam, the probable saving in this way being about one-third of the coal and water in our estimates. Making this correction, we have $657 to divide, bringing the cost of equal gas down to $1.46½ per thousand and paying another ⅔ of 1 per cent. to the company.

A further great reduction in cost is possible by extending the average life of the carbon filaments to 1,200 hours and by reducing the cost of renewals to 45 cents. This would make a reduction of $9,039 per annum, reducing the price of gas to $1.25 per thousand, and paying an additional 10 per cent. to the shareholders.

The introduction of the electric light, if conducted under the guidance of educated and experienced mechanical engineers, and if properly done, will yield immediate and ample returns. As at present developed, it can compete with gas at $1.69 per thousand feet and pay the shareholders 30 per cent. per annum on their investment. If the improvements indicated above are introduced, it can compete with gas at $1.25 per thousand feet and at the same time pay 47⅔ per cent. to the electric light shareholders.

* Summary of a paper read before the Am. Assn. for the Advancement of Science, August, 1884, by Mr. Allan Stirling.

A Rotary Engine for Electric Lighting.

We illustrate on this page a new rotary engine, for which the patents have just been issued. It is known as the Harrington engine, and is owned and made by the Harrington Rotary Engine Company, 123 Clinton street, Chicago. It is stated that this engine, whose construction is based on principles hitherto unemployed, possesses the capacity for high speed and the steadiness that are indispensible in an engine for electric lighting. A description of the engine, as illustrated by the cuts, has been furnished us. As will be seen, the engine is compact in form, occupying but little floor space. It may be made of any size, double or single, and is intended for general use, The several parts are simple, and are so made as to possess great strength and capacity to resist wear. Care has been taken to provide complete lubrication and to avoid friction. The chief characteristic or principle of this engine is the maintenance of an accurate steam and mechanical balance and the avoidance of cross pressure. The power is applied directly to the work, the only friction being that of the steel shaft in phosphor-bronze bearings. Referring to the cuts, Fig. 1 shows the engine and a Van Depoele lighting dynamo on the same shaft, all connecting mechanism being done away with and pounding obviated. There are but two parts to the engine (two discs, which supply the place of all the ordinary mechanism) both of which are large, solid and durable. These discs have a bearing surface of several inches on each other, preventing the passage of steam between them—a feature peculiar to this engine. Fig. 2 represents an end elevation partly in section, showing the piston *A* and the abutment disc *B*, in the position assumed in the instant of taking steam through a port from the valve-chamber *E*. Fig. 3 is a vertical section through the centre of Fig. 2, showing the relations of the discs *C* and the abutment discs *B* and gear. The piston discs and gear are attached to the driving-shaft *H*, and the abutment discs and gear are attached to the shaft *K*. These shafts, *H* and *K*, as above stated, run in taper phosphor-bronze bearings, which are adjustable for wear or other causes by the screw-caps *O*. The whole mechanism is kept rigidly in place by the flanged hub *r* bolted securely to the cylinder-head *F*. These flanged heads project through the cylinder-head, touching the piston disc, and thereby prevent any end motion of the shaft *H* or its attachments. The abutment discs and shaft are furnished with similar inwardly projecting flanged hubs, which are provided with a recess *I*, Fig. 2, on their periphery, located radially between the shaft *K* and the clearance space *J*. Into this recess steam is admitted—through an inlet in the cylinder-head not shown in the cuts. By this means the shaft *K* is relieved of all side pressure. The exhaust-port, which is very large and relieves all back pressure, is shown at *D*. The pistons and discs are made to balance at the speed at which theengine is intended to run. The steam-valve, for which patent is pending, is new in principle. It has a uniform rotating motion and, like the engine, is steam and mechanically balanced. The governor is located in the flywheel and actuates the automatic cut-off, with which it is directly connected, without the intervention of an eccentric, in such a way as to vary the cut-off without changing the point of admission. By this means is secured uniformity of motion under variable loads with variable boiler pressure. It also secures the advantage resulting from high initial and low terminal pressure, with small clearances and absence of compression, giving a large proportionate power and smooth action.

Expansion has been excellently provided for, the steam passing entirely around before entering the cylinder. These engines are mounted on a bed-plate which may be set on any floor without especial preparation therefor. The parts are all made interchangeable. A permanent indicator is provided which shows the exact point of cut-off. The steam-port is exceptionally large, being one-fourth of the piston area. Reciprocating motion is entirely done away with. The steam is worked at the greatest leverage of the crank through the entire stroke. Among the other chief advantages claimed for this engine are direct connection to machinery without belts, etc., impossibility of getting out of line, uniform crank leverage, capacity for working equally well slow or fast, etc. It has but one valve, which is operated by gear from the shaft, as shown, traveling at one-half the velocity of the piston.

With this engine a speed of 5,000 revolutions per minute is easily attainable, while, as a matter of fact and curiosity, a speed of 8,000 revolutions per minute has been obtained. An engine of this class was run at the Illinois Inter-State Exposition at Chicago for six weeks at a uniform speed of 1,050 revolutions per minute, furnishing the power for twenty-three electric arc lights, with a steam pressure not exceeding fifty-five pounds per square inch, and cutting off at from one-tenth to one-sixth of the stroke. It was taking steam from a large main-pipe, so there was no opportunity for an exact test of the amount of fuel used, but from a careful mathematical calculation it must have been developing one horse-power from three pounds of coal. The inventor claims that, as his engine works the steam expansively, even better results would have been obtained had the engine been furnished steam at 100 pounds per square inch. The motion under all circumstances being continuous, the shock of incessantly starting and stopping the masses of metal making up the engine is avoided, and the expenditure of power therein saved. That this is a departure from the ordinary types of rotary engines that have been built, tested and rejected, is proven by the fact that all of the seventeen claims made were allowed practically without amendment by the Patent Office at Washington. Patents have also been applied for in all foreign countries.

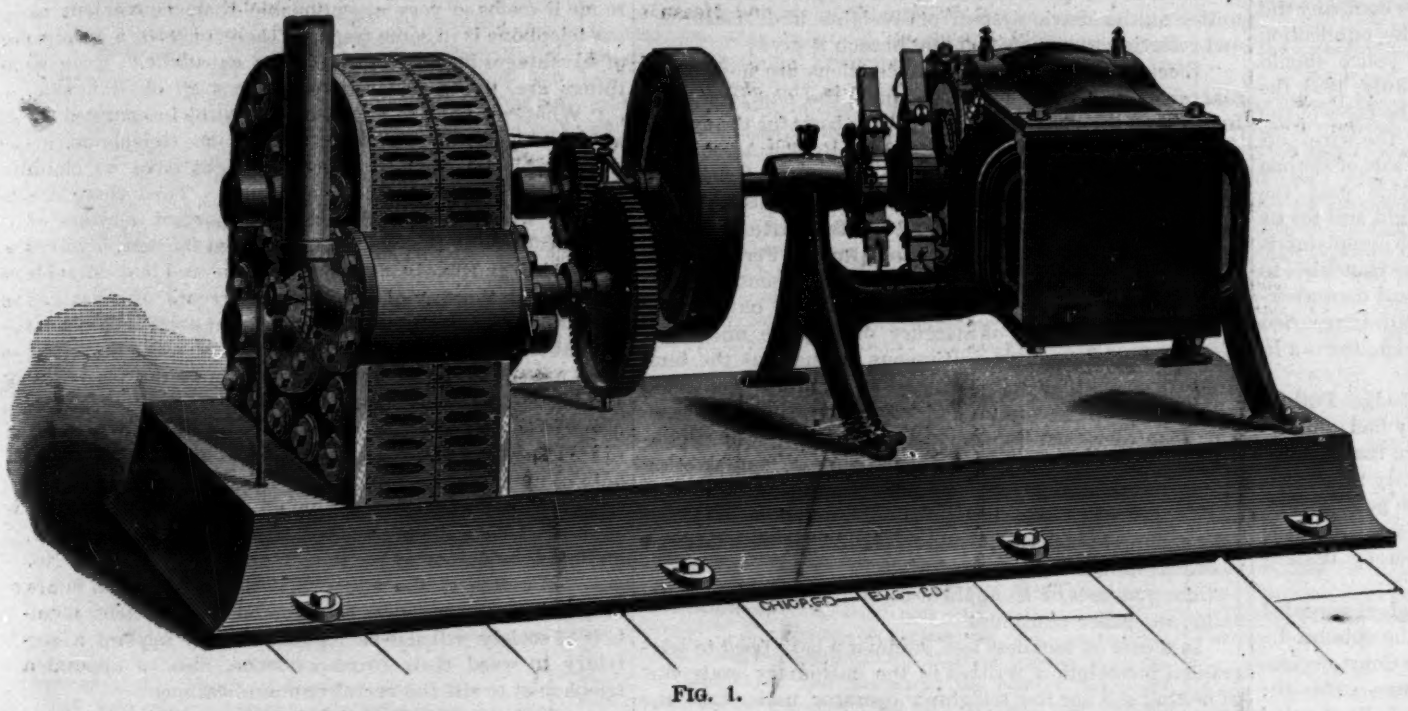


FIG. 1.

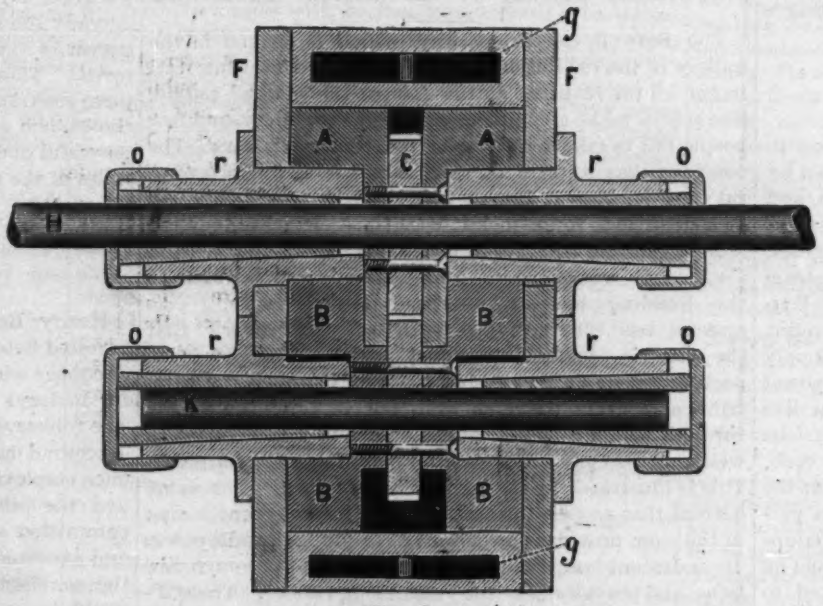


FIG. 2.

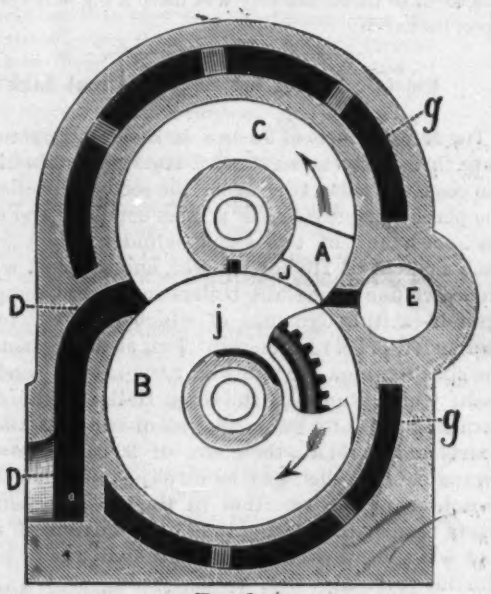


FIG. 3.

The Electric Lighting of Railway Trains.

In THE ELECTRICAL WORLD of Nov. 15 we noticed the successful lighting of an English railway train, running between Manchester and Liverpool, by the electric light, with a Brotherhood three-cylinder engine and Siemens dynamo coupled together and fixed upon the back of the tender. This train has run continuously ever since the first trial and another modification of the same system is now in active operation on the Great Eastern Railway upon certain of the trains on the Chingford line. In this arrangement a Heenan & Froude spherical engine, coupled directly to a dynamo, is mounted longitudinally upon the barrel of a locomotive boiler, which supplies the H. & F. engine with steam, its regulator being placed under command of the locomotive driver. The dynamo runs at 1000 revolutions per minute, giving a current of 42 ampères, with an electro-motive force of 48 volts. The train of 15 carriages is lighted by 60 Woodhouse & Rawson lamps and the illumination is far superior to gas. The connection between the engine and train and between the various carriages has been very carefully worked out. At the end of each carriage there are a pair of male terminals, and the space between the adjacent carriages is bridged by a pair of flexible conductors laid together, and furnished at each end with a double spring socket, which fits the terminals and obtains a strong frictional grip on them. All the parts are very strongly constructed, so that they can be found in the dark, and will suffer no injury from the roughest of usage.

The electrically lighted train has now been running about two months, and the wiring of other trains is being actively proceeded with.

There are now two thoroughly efficient methods of electric train lighting at work in the English metropolis, and it is possible, therefore, for the railway companies to institute a reliable comparison. The Brighton system is encumbered with from 22 cwt. to 30 cwt. of secondary batteries, and with the loss which arises from the double conversion of the energy. On the other hand, the light is always available whether the engine is backed on the train or not and the power is derived from an economical motor. On the Great Eastern trains the total weight is exceedingly small, only 4 cwt. or 5 cwt., and the current is applied directly to the lamps without any loss. The disadvantages are that when the locomotive leaves the train all the lights go out, and that the spherical engine may be expected to make a greater demand for steam, for a given power, than a locomotive. The relative merits of the two systems would seem to depend greatly upon the circumstances in which they are tried. On a small scale the balance of advantage lies with the dynamo in the van, since the train is self-contained, and when the usual engine is in the shed, the light is equally well maintained by any other, and no alteration of the ordinary method of working the traffic is required. On a large scale these advantages disappear, since, if all the engines working on a given section were fitted with dynamos, the trains would be equally well served by any of them, and arrangements might be made to always maintain the lights by attaching a fresh engine for the return journey before the first was uncoupled.

Furnishing Electromotive Force.—In Philadelphia, on Christmas Day, a most sensible and kindly departure in the history of telegraph companies was made by the Baltimore & Ohio, which gave a grand dinner to the uniformed boys employed as messengers in their district system. The services of a fashionable caterer were called into requisition, and he presented a menu beginning with raw oysters and running through five courses, with coffee at the end. Manager Curl addressed the boys, telling them that the dinner was given as a recognition of their faithful services in aiding the company to build up the messenger service in this city. A suitable present was made to each of the boys prevented from attending the dinner by service on the streets and in the offices.

A Celebrated Telephone Case.

The decision rendered by the supreme court in the case of the Wisconsin Telephone Company versus the City of Oshkosh, Wis., has created no small amount of talk and revived many reminiscences of this somewhat celebrated case, of which we give a brief review. In January, 1880, the Oshkosh Common Council passed an ordinance granting permission to George W. Athearn, his heirs and assigns, the use of the streets and alleys of that city for the erection of telephone poles and maintenance of a telephone line, and Mr. Athearn built and maintained what was known as the Oshkosh Telephone Exchange. In March, 1881, he sold out to the Wisconsin Telephone Co. In June, 1883, the Council repealed the ordinance of 1880, and passed another requiring of the Wisconsin Telephone Co. the payment of a license fee of $300 per year, and further provided that, if the telephone company did not pay the license within ten days after the publication of the ordinance, the mayor and chief of police should have any or all of the poles cut down. In July, 1883, the mayor and chief of police cut down one of the poles of the main line on Division street, and also cut the wires off close to the cross-bars on the two poles each side of the one cut down. The company shortly after this paid the license under protest, and immediately brought suit for its recovery. In the defendant's answer to the complaint it was set up that the ordinance granting the franchise to Athearn was null and void, as the council had no authority to pass such an ordinance, and that it was duly repealed by the ordinance of June 7, 1883, under which the tax license fee was imposed.

To this answer plaintiff demurred, and Judge Pulling sustained the demurrer, holding that the city had authority to pass the ordinance granting to Athearn the right to erect poles in the streets and alleys of the city; and that after Athearn or his assignee had erected the poles and established the telephone exchange at great expense, the city could not repeal the ordinance and thereby destroy vested rights.

To this order of the Circuit Court the defendant appealed to the Supreme Court. The substance of the opinion delivered by Judge Cassidy is as follows: The Court decides that the construction of telephone lines comes under the law authorizing the construction of telegraph lines; that the lines in Oshkosh were constructed in accordance with permission given by the city, and that the company occupies the streets not only by express grant of the Legislature, but also by the city ordinance; that the city of Oshkosh cannot impose another license without authority from the Legislature, and has no authority to remove the poles and wires from the streets, although it has the right to regulate their construction so as not to obstruct the streets; that this power to regulate must be used in a reasonable and just manner, and not to the extent of confiscation or of wholly excluding the telephone company from the city; that Oshkosh has no power to license telephone or telegraph companies, and that the ordinance is void.

The city officials are downcast over the result of the trial, and seem to think the city will have a big suit for damages upon its hands.

Electric Lights for English Legal Lights.

The Royal Courts of Justice in London, England, are to have their dusty and befogged atmosphere illuminated by the electric lights, this being the second installation, and the plant now provided is a most complete and expensive one, consisting of two single-cylinder Galloway engines, each capable of 110 horse-power, and supplied with steam from two fine Lancashire boilers and eight Crompton-Burgin self-exciting dynamos, of which one, with one engine and boiler, is held in reserve. Two of the dynamos supply the six Crompton arc lights of 2,000 actual candle-power each, which illuminate the Great Hall, and the other five furnish current for 600 incandescent lamps in the various courts and corridors; these are of 20 candle-power each, arranged in parallel, and by an adjustment effected at the switch-board the variation in their requirements is perfectly regulated. During the Court vacation all the lamps and wires were overhauled and the circuits tested, and on Monday evening, Dec. 8, everything was expected to go off, when the electricity was turned on, with a blazing success. There was, however, "a hitch and a kick" somewhere, for the *Times* contained the following dismal story: "The reinstallation of the electric light has been anxiously expected by every one connected with the courts, for the *ad interim* arrangements for lighting them have been of a very feeble character, and it has lately been at times almost impossible to see either to read or to write. This afternoon, however, Court No. 4 has been in worse plight than ever, for after the electric light (the installation of which was supposed to have been completed yesterday) had been turned on, though it burned brightly enough at first, in a very few minutes, after getting gradually dimmer, it expired altogether, and there was nothing to meet the emergency, for the scanty supply of candles and lamps which have hitherto been forthcoming did not make their appearance, and on inquiry it turned out that all the candles had been withdrawn, and that none of the lamps had been trimmed, presumably in reliance on the electric light. The consequence was that the learned judge had perforce to rise shortly before the usual time, and great difficulty was experienced in making up to-morrow's paper for want of light to read the list."

The English electricians will, however, remember their Watts, and "try, try again" until success crowns their efforts, and if the learned judge ever gets "stuck" with his papers it will not be the light of electricity that he will have to blame for the want of luminosity in the transaction of his business.

The Metric System of Weights and Measures.

From the latest number of the *Journal of the Association of Engineering Societies*, Boston, we extract a few points in regard to the metric system of weights and measures which is now being discussed and pressed upon Congress for action in regard to its legal adoption. The paper from which we quote is the "Ninth Report of the Committee on the Metric System of Weights and Measures," and referring to our own special branch it says;

"Electrical science, whose applications are now being marvelously developed, has its units, the *ohm*, *volt*, etc., founded on the metric measures. The basis for the system was furnished by a committee of the British Association for the Advancement of Science. At an international convention, which met at Paris in April, 1884, where there were nine delegates deputed by the British government, and where the United States, Russia, Persia, China and Japan were also among the nations represented, it was agreed, after ample discussion, that the legal ohm is the resistance of a column of mercury one square millimeter in cross-section, and 106 centimeters in length at the temperature of melting ice. This and other units connected with the centimeter, gram and second were indorsed. The American Electrical Conference, called together in Philadelphia, 8th September, 1884, for the purpose, among other things, of taking authorative action respecting these electrical standards, favored their adoption, and deemed it of national importance that Congress should fix standards of electrical measures."

Among notices of its application and illustrations of its value, the paper continues:

"In a case of sickness last summer a lady tried to telegraph a prescription written in the customary style, but as neither she nor the telegraph operator understood the expressions of quantity they naturally failed to communicate them correctly, though the names of the ingredients were successfully transmitted. If the metric system were in use by everybody prescriptions could easily be telegraphed. Into the same category with the scruple and minim of the apothecary must be put the surveyor's link, the perch of masonry, the miner's inch, the jeweler's carat and the horse jockey's hand."

The committee having these matters in hand are enthusiastic, earnest and persistent. That there is great room for improvement in present methods is certain, and the change proposed has very many excellent and important features.

The Bidwell Railway at the Boston Exhibition.

The Bidwell electric railway, which is located in the gallery of the exhibition, will be one of the most interesting of all the features at the fair to the general public. The tracks make a complete circuit of the gallery, and few people fail to take a ride upon the company's cars. The company has a train of two cars, which are of beautiful workmanship and richly upholstered. It probably will be a surprise to some to know that the electrical current which supplies the power is obtained from the Weston Company's works on Stanhope street, and brought to the building by an overhead electric wire. This system has proven the truth of the theory that the electric current loses but little of its power in passing through a motor, and it not only propels the cars, lights and heats them as well, but it lights the streets through which it passes, and lights and heats houses as well, and also provides power for manufacturing purposes. This is illustrated by the exhibit at the fair. The same current that propels the cars lights 20 incandescent lamps in the cars, provides power for 12 Weston 125-candle power incandescent lamps in the main hall, heats the cars, runs a lathe and provides heat for vulcanizing rubber. These diversified uses to which the current of electricity is put prove the fact that one current can be used for more than one purpose at the same time. This system proposes to furnish power and cars for either surface or elevated roads. On surface roads the conductors are placed in a viaduct between the tracks. This is covered over with a surface plate, in which a slot is cut its entire length, through which the electric contact is made between the motor on the car and the conductor in the viaduct.

The conductors are suspended under the surface plate, an arm drops from the bottom of the car into the slot, and by an ingenious arrangement of wheels and springs an even pressure is maintained on the conductors. Through this arm the current is conveyed to the motor in the car. A novel arrangement is attached to the car for the purpose of sweeping out any accumulation of dirt in the viaduct and the feeding of salt in cold weather to keep the interior of the viaduct clear of ice and snow in the winter weather. There is a special arrangement of switches, cross sections and turnouts used when the current is to be used for lighting the streets and houses. The cars are backed just as easy as driven forward by simply reversing the current. The heating of the cars is done by simply passing the current through resistance metal, which, in the cars at the fair, is German silver. The cars on exhibition are supplied with one five-horse power motor, weighing about 600 pounds, and carry with perfect ease 50 or 60 passengers.

"Not Quite So Free, Please."

A correspondent writes as follows to the *Scotsman*, under date Edinburgh, December 9th, 1884: "The telephone companies appear to propose opening places of call where any person off the street may for a trifling payment—a penny is suggested in some places—ring up any subscriber, and insist on holding a conversation with him. I do not think the subscribers have been consulted about this, and to me it seems so very objectionable that, convenient as the telephone is in some respects, there may be a balance of advantages in favor of ceasing to subscribe. Even as things are, the considerations are not all on one side.

"Whatever you are engaged in must be interrupted to attend to some one speaking through the telephone, although if he appeared in person he might have no claim to such prompt and exclusive attention. Then there are persons who insist on discussing important matters of business through this medium, which, at the best, involves a hurried and indistinct conversation and considerable difficulty in the way of a trustworthy record of what has passed. Subscribers have the security at present that none but subscribers can address them in this way, and that these are equally interested in the telephone not becoming a nuisance; but if everybody who has a penny or threepence to spare can insist on being listened to by any of the leading business establishments in a city, we shall only be able to protect ourselves against triflers and intruders by paying less regard to all telephone communications. I hope the project will be reconsidered." It will, no doubt, be necessary ere long to add to "Telephone No. ——" a notice to the effect that between certain hours only will communication be afforded. Prominent members of society will also be obliged, as they appoint a secretary to weed their correspondence, also to appoint a telephonist to sift the verbal communications.

The Lick Observatory Apparatus.

The San Francisco *Call*, of Dec. 16, says: The Lick Observatory, on Mount Hamilton, even without the great telescope in course of construction, is already one of the most complete in the world. There has recently been added a meridian circle, made by Refsold, of Hamburg, and a house has been built for it. Prof. Holder thinks it is the most perfect of its class in the United States, if not in the world. Two discs for the great 36-inch lens have been successfully cast, and a member of the firm of Alvan Clark & Sons recently went to Europe to examine them, and to ascertain whether either of them is suitable for the lens. If a perfect disc has been obtained, it is thought that the great refractor may be mounted and in use by 1886. Already the observatory has a 12-inch equatorial, a 4-inch transit, a comet seeker, a vertical circle, and a 6-inch equatorial. Then there are five clocks, connected by a complete electrical system. Superintendent Fraser states that the 36-inch glass, when finished, will be by far the most powerful one in the world, bringing the moon within 30 miles of the earth, whereas 80 miles is the limit of existing telescopes. The wonders which such a glass will disclose can hardly be foretold.

Robbed by its Employes.

Henry Burke, Thomas Morris and John Wilson were arrested Saturday night, Dec. 27, for stealing 1,000 pounds of copper wire from the warehouse of the Edison Company for Isolated Lighting, at Hudson and Thirteenth streets. The robbery—the third committed at this place recently—occured on Dec. 14. Burke is an ex-convict, and was once employed by the company. He confessed that he and the other prisoners, also employés of the company, committed all the robberies, two of which were planned and executed before he was discharged. He had to close the warehouse, and he left the front doors so that they could be pushed in. The robbery of Dec. 14 was accomplished by entering the warehouse by a scuttle and wrenching the padlocks from the front door with an instrument provided by Wilson.

The Telephone in New Orleans.

NEW ORLEANS, Dec. 24, 1884.

To the Editor of The Electrical World:

SIR: In the name of all that is good and holy, what is the object of your "Explorer" in sending to your paper such statements as appear in the last two issues of THE ELECTRICAL WORLD. First, "The National Improved Telephone Co. has a fine location under the stairs leading to the gallery of the Music Hall and to do them justice they are making the most of it." No fault to find so far. "They have a conspicuous and ornamental sign." What good business has not a good one? "A neat platform." No platform; have no need of one, as we stand on our own bottom. "A pretty carpet and they promise a copious and brilliant exhibit." Correct.

"It is now said that since the decision in the case, Bell

vs. Drawbaugh, this company announces its determination not to infringe the Bell patents by offering its patents for use or sale, but simply to make exhibition thereof, so that the public will be convinced of the immense superiority of their instruments, and make such a popular demand for them that the Bell Company, in self defense, will be compelled to purchase their patents and introduce them." Now, sir, by what authority does your "Explorer" make such statements? Is not the fact sufficient that we are already using and offering for use our telephones, and intend to offer them to the public here and elsewhere very shortly? This latter statement of your "Explorer" is a barefaced and outrageous "lie"; and if "Explorer" is your accredited correspondent, would it not be better to find out the truth from us before sending the statements to you, who, without any hesitation whatever, publish them, and you having at the same time the only authority *of its being said so*, "according to 'Explorer's' statements"? It is surprising that the leading electrical journal of the country is so ready to publish such statements, only on the assurance of a correspondent *that some one said so*. I am pretty sure that no one connected with this company said so, as the intentions are directly opposite. It is rather hard that a company should have to labor under any such wrong impressions as your publications are apt to place them, because your "Explorer" does not see fit to call on any one connected with this company for the endorsement of his hearsays before sending them to you, who at once rush them into your columns. As I told you in a former letter, every one connected with this company is a gentleman, and any one whom they come in contact with in an open and gentlemanly manner is treated as a gentleman. "Explorer" neglected to say that this company furnishes the telephonic service, which Capt. Walshe has organized by the distribution of thirty stations. He also omitted to state that the *four-sided switch-board* was a new multiple system, and vastly cheaper, simpler and more practical than anything in use. Claiming, as you do, that you represent no particular interests, I think we are entitled to a proper understanding through your paper. A SHARK.

Mathematical Electricity.

To the Editor of The Electrical World:

SIR: Will you please answer the following question through THE ELECTRICAL WORLD? What branches of mathematics should one understand who wishes to become an electrical engineer, and how far is it necessary to go in each branch? BERT BUYE.

[ANS.—To become an investigator in electricity, one should know all the branches of mathematics; but a practical engineer, *i. e.*, one who is supposed to be proficient in designing and superintending the building of electrical machines, instruments, plants, etc., needs the cultivation of the mind obtained by mathematical studies more than he needs the mathematics itself; so that a thorough knowledge of algebra and a general knowledge of geometry are sufficient. Algebra is constantly used in working out calculations of the relations of the elements of electrical energy; in determining sizes of wire for given currents; in converting mechanical energy into its equivalent electrical energy; in calibrating electrical instruments; and in applying long and arbitrary formulæ. Such things as the above have been accomplished by men ignorant of mathematics, but it has been done unintelligently and gross errors have consequently occurred.

Trigonometry is often used in electrical mathematics, and is a study which can be easily comprehended and applied by one who is first thoroughly prepared in algebra, and who understand at least the general principles of geometry.—EDS. ELECTRICAL WORLD.]

THE TELEGRAPH.

The submarine telegraph cable between Senegal and France has been completed.

Big Figures.—The telegraphic revenue of England from April 1 to Dec. 1, 1883, amounted to $6,075,000, and for the corresponding months of the present year to $6,104,000.

The Faraday.—A dispatch dated St. Johns, N. F., Dec. 24, 1884, says: The cable ship Faraday is just in, having repaired the Mackay-Bennett cable. She sails to-night for London.

Telegraphic Communication at Sea.—Telegraphic communication has been established between a sunken lightship and the shore at Ramsgate, England. The messages are conveyed direct to the local post-office. This means of communication will be of great value, as the lightship will be connected with several others, and it will enable assistance to be dispatched to distressed vessels with much greater promptitude than heretofore.

The B. & M. Co.—Several share and bond holders of the Bankers and Merchants' Telegraph Company held a meeting on Friday, 19th ult., to suggest, discuss and, if possible, adopt self protective measures. That something ought to be done to prevent the property from going to complete ruin was admitted by all present, and into the hands of a committee, consisting of Dwight Townsend, John A. Washburn and William G. Davis, were committed the interests of the security holders for care when some concerted action on the part of the bondholders has been taken.

They Can Lay Wires.—In Chicago on Wednesday, Dec. 24th, the State court of Illinois dissolved the injunction against the Baltimore and Ohio Telegraph Company, which was obtained several months ago on the application of the Chicago Sectional Underground Cable Company, restraining the Baltimore and Ohio Company from laying underground wires in Chicago in consequence of an alleged exclusive grant for such work from the Chicago Council to the Sectional Company. The Baltimore and Ohio Company at once completed its arrangements, already begun, for laying underground wires from its main offices to the new Board of Trade Building.

All the Modern Improvements.—The San Francisco *Call* says: The Japanese are very precise and correct, as a rule, in their pronunciation of English, as they learn more or less like parrots. One day a man went into the Hiogo telegraph office with a message to be sent to Osaka. The polite Jap took it from him, looked blandly over it and then said: "You—cannot—send—this—message—to-day." "Why?" "The—gentleman—who—takes—charge—of—the—telegraph—office—is—drunk." "Indeed! is he often taken like that?" "He—is—very—frequently—drunk." "Well, what am I to do?" "If—you—will—leave—your—address—I—will—send—and—tell—you—when—he—is—sober."

A Manager Mysteriously Missing.—The community of Reading, Pa., was considerably perplexed on Christmas day by the announcement that Frederick H. Gartlan, a well-known citizen, had disappeared in a very mysterious manner. Gartlan held several positions of trust, as he was manager of one of the Philadelphia & Reading telegraph offices here, beside being one of the coal agents of the company at this point. He was last seen on Saturday. His friends have scoured the greater portion of Philadelphia and New York, whither it was supposed he had gone, without finding any trace of him. Some think he sailed for England, of which country he is a native. He is about fifty years of age and lame. He is highly educated and over twenty years ago was connected with one of the great London dailies. His family are greatly exercised over his continued absence. He has a wife and three small children. He is a first-class operator and has been in the service of the company for many years. An investigation will be made to-morrow as to the cause of his disappearance.

Who Shall the Receiver Be?—The hearing in the case of Gen. Mahone and others against the Southern Telegraph Company, for the appointment of a receiver, was continued on Wednesday, Dec. 24, in the United States Circuit Court at Baltimore, before Judges Bond and Hughes, sitting as for the Eastern District of Virginia. The case was argued at Norfolk the week previous. After brief statements by the counsel, Mr. Thom, representing the Greenville (Va.) Land and Lumber Company, nominated Robert T. K. Bayne, of Portsmouth, Va., as receiver. Mr. John S. Wise, representing Gen. Mahone, opposed the nomination of Mr. Bayne and nominated the present temporary receiver, the United States Marshal of Virginia. Gen. Bradley T. Johnson, representing the Bankers and Merchants' Telegraph Company, nominated Alexander H. De Haven, of New York, and William W. Maris, of Philadelphia. Judge Hughes said it was important to preserve the interests of the corporation, and that the interests of all the parties were identical. The court was of opinion that one receiver ought to be appointed and not two, and that all the parties should agree on that one. The court gave them until Tuesday, the 30th, and then named, as Receiver, Mr. A. S. Boulware, of Richmond.

THE TELEPHONE.

English Enterprise.—The Lancashire and Cheshire Telephonic Exchange Co. held a special meeting on Dec. 10, in Manchester, England, and it was then announced that arrangements had been made with the Post-Office authorities for the extension of business and "call" offices will be opened at various points in Manchester and Liverpool and at railway stations within the district, thereby establishing communication between the principal town of Lancashire, Cheshire, and Yorkshire by means of trunk lines, offices for domestic subscribers being established in most of the towns. The receiving and sending of telegrams by telephone means has also been provided for.

Looking after Bell Interests in Europe.—*The Electrical Review*, of London, dated Dec. 31st, furnishes the following item: Mr. J. J. Storrow, counsel for the American Bell Telephone Company, left New York for Europe on Friday, November 7th. It is said to be not unlikely that his journey is connected with the litigation now threatening between the United Telephone Company and the new company owning the Valve telephone. The latter was the subject of a question in the House of Commons last week, when Mr. Shaw-Lefevre, in reply to Mr. Kenny as to the merits of the Gower-Bell and the Valve telephone, said that the Patent Office had obtained additional information, but it was not yet open to the inspection of the public.

The Bell Telephone Company's Business.—The net output of telephones for the month ended Dec. 20 was 379, against a net loss of 335 the previous month, and 419 for the same month last year. The net increase for 10 months of the fiscal year, compared with 1883 and 1882, is as follows:

	1882.	1883.	1884.
March	5,192	4,789	3,252
April	6,690	7,342	4,483
May	7,469	6,758	5,023
June	6,362	7,038	4,568
July	3,787	5,846	2,278
August	4,678	3,560	616
September	4,276	4,365	1,374
October	4,136	3,706	229
November	5,033	3,811	*335
December	4,532	4,191	379
Total increase	52,155	51,365	21,937

* Net loss.

Secrecy in Telephone Messages.—In order to call one of its subscribers without troubling the others, the Société Générale des Téléphones of France has hitherto placed at each station, and also at the central office, dials which work simultaneously when the first current is sent along the line, and show when to ring in order to call any particular subscriber. For this purpose they work hands which move round circles divided into equal sectors, each of which corresponds with a station; and the call is heard at the station answering to the sector on which the index may rest when the call is made from the central office. This arrangement has the disadvantage of making known at all the stations, by the motion on all the dials, that a message is about to be sent along the line, so that third parties may conceive the idea of listening. A recent improvement, due to one of the engineers of the Société Générale des Téléphones, permits of avoiding this difficulty. Instead of there being a dial at each station, one only is placed outside the subscribers' premises; and, in addition to the two wires which generally constitute the secondary circuit, there is a third, so arranged that when the central office is in communication with one of the stations, this communication is interrupted as soon as a third subscriber takes up his telephone.

THE ELECTRIC LIGHT.

No Dull Times There.—We learn that the Thomson-Houston Company are so busy with their orders that they are running their works night and day.

Jacksonville, Fla.—The visitors to the above city, as well as the citizens, will be "enlightened" in a few days by a first-class Thomson-Houston plant.

For a Photograph Gallery—Stein Bros., the photographers of Euclid avenue Cleveland, O., have just added a Thomson-Houston machine and focusing lamp to their gallery, and report it a grand success.

Chicago's Government Building Electric Light Plant.—The engines intended to run the electric light in the Government building of Chicago are now being put in place. The engines are two in number, each 100 horse-power, and one of them will be kept in reserve in the case of an accident to the one in operation. The lights are to be in operation by Jan. 1.

The Electric Light at the New York Capitol.—The lighting of the Capitol, at Albany, with electricity has proved quite satisfactory. All the lights of the building are fed from powerful dynamos in the basement, which constitute the most costly local electric light plant in this country. The dynamos feed 61 arc and 1,386 incandescent lamps scattered throughout the great building.

Finding Firm Footing in France.—The French Edison Company, "Societé Electrique Edison," evidently has its hands full of business, and has just supplied 25 lamps to a dye-works at Puteaux, near Paris; 25 lamps to a factory at Lyons, 100 lamps in a spinning mill at Pont-Audemar; 40 lamps to a lace factory at Tarare; and 500 lamps to the spinning mill of M. Droulers-Vernier at Lille.

Lighting R. R. Trains by Electricity.—England is active in applying the electric light for the illumination of railway coaches. An E. L. plant is being put down for the carriages of the Great Eastern Railway, and seven trains lighted by electricity have been running for three months without interruption. The dynamos are placed on the locomotive boiler behind the dome and clear of the side view of the driver, they are driven by a high speed spherical engine; steam is taken from the dome and exhausts by the chimney. The engine, which develops 10 horse-power and makes a thousand revolutions a minute, weighs only 57 pounds, and with the dynamo is 3 ft. 3 in. long over all by 13 in. wide and 2 ft. high, the dynamo, engine and bed complete weighing 3½ cwt.

The E. L. on English Railway Trains.—For the Great Eastern Railway, England, an entire electric lighting installation for the passenger carriages is fitting up by Messrs. Heenan & Froude, of Manchester. At present, seven trains supplied with the electric light have been running for nearly three months without the least trouble occurring, and the company is so satisfied with the experiments that they have in contemplation the introduction of electric lighting for both their local and through traffic. The engine for driving the dynamo machine is one of Messrs. Heenan & Froude's Tower Spherica engines, and the dynamo machine is made by Mr. E. Compton. The engine and dynamo, which are only 3 feet 3 inches long all over, 13 inches wide and 2 feet high, and with the plate and couplings complete, do not weigh more than 31½ cwt., are placed on the boiler of the locomotive in the rear of the dome, where they do not interfere with the side view of the driver, and the steam, which is taken from the dome, exhausts up the funnel. The wires and lamps are so arranged as not to interfere with oil lamps being put on as a moment's notice.

Heavy Electric Light Business.—The Gulcher E. L. Co., of England, has lately installed twenty-four 800-candle and two 2,000-candle arc lamps, supplied by a No. 5 dynamo, for Messrs. A. Ransome & Co., of Chelsea, and ten 800-candle and six 2,000-candle arc lamps, supplied by a No. 4 machine, in the foundry of Messrs. Ransome, Josselyn and Woods, of Battersea. Gas has been entirely superseded in the large erecting shop of the Coalbrookdale Company, by one 3,000-candle and two 1,000-candle arc lamps, supplied by a No. 1 dynamo; and although the latter is driven by the same engine as the shafting, the power absorbed by which is not at all constant, the light is remarkably regular. The Gulcher Company has added to the electric lighting plant of the Patent Shaft and Axletree Company, Wednesbury, which now consists of five 3,000-candle and six 2,000-candle arc lamps supplied by a No. 4 dynamo. The same company is lighting a pit mouth of the Tir Pentwys Colliery Company, in Wales, with a 3,000-candle arc light, which has taken the place of large fires consuming from 10 to 15 cwt. of coal nightly, while the offices are lighted by incandescent lamps, all being supplied by a No. 1 compound-wound dynamo. The rag-sorting department of Messrs. E. Fox & Sons' paper mills at Dewsbury is lighted by thirty-two 20-candle incandescent lamps, supplied by a No. 1 dynamo, while the yard is illuminated by an arc light. The Gulcher Company has also been instructed to light with incandescent lamps the saw-mill of Messrs. J. & C. S. Young, of Salisbury, who have ample power and anticipate a great saving of expense.

MISCELLANEOUS NOTES.

A Very Tasteful Calendar.—We have received from the American Electrical Works, Providence, R. I., a very tasteful calendar for the new year. It bears as ornamentation the

vignette of a pretty girl (telephone operator?), having a background of foliage, and at the bottom of the card is a candle, around whose bright flame several moths are fluttering. This we take to be emblematic of the folly of the people who won't use electric light, but stick to candles and the like. The whole is printed in tints, and is suspended by telephone cords.

Long Lived Cables.—In 1865 a cable was laid between Kreesbran and Haardt, near Bregenz, by the Wurtemburg Administration of Telegraphs, and it continued in uninterrupted use until a short time since, when it became inoperative, and upon raising it out of the water a complete rupture was discovered, the conductors and wires of the armor being gnawed asunder. Upon renewing some 1,300 feet, however, it was found to work as well as when new. Between Frederickshaven and Romanhorn there is now a cable in excellent order that has been laid for thirty years.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange, and elsewhere are as follows:

TELEGRAPH.—Am. Cable, b 52 a 54; B. & M., b 2½ a 4; Mutual Union, b 12; Postal Stock, a 3; Postal sixes, a 26; Western Union, b 54¼ a 54⅝.

TELEPHONE.—Am. Bell, b 259 a 260; Erie, b 18 a 19; Mexican, b 1¼; New England, b 35½ a 36.

ELECTRIC LIGHT.—Edison, b 60.

BUSINESS NOTICES.

Some Striking Testimonials.—The Jerome Kidder M'f'g Co., 820 Broadway, New York, have enlarged their forty-page catalogue to sixty-four pages, giving much new and valuable information. We give below four testimonials received by the company during the year:

MEMPHIS, Tenn., July 6, 1884.

JEROME KIDDER M'F'G CO., 820 Broadway, New York:

Dear Sirs: I received your letter and catalogue in due season * * * I have used your No. 5 instrument for a year and a half while in charge of the Meribah Mineral Springs and Hydro-Electro Therapeutic Institute of Stratford, Ont., and therefore am thoroughly impressed with their virtues, in my own case especially. After suffering with sciatica for years, one application effectually relieved me.

I am yours respectfully,

DR. C. G. B. KLOPHEL, No. 39 Poplar Street.

RUSHFORD, N. Y., Aug. 2, 1884.

JEROME KIDDER M'F'G CO.:

Gentlemen: In the month of March I became paralyzed from spinal difficulty, and was perfectly helpless for more than two months. I sent for one of your batteries, and thanks to it and you I am able to stand on my feet again, and can walk with a little assistance, and in a short time expect to be able to walk alone. The battery is a great institution, and I don't know what I would have done without it. Very respectfully,

C. J. HARDAWAY, Rushford, Allegany County, N. Y.

MACON, Mo., Jan. 30, 1884.

JEROME KIDDER M'F'G CO., 820 Broadway, N. Y.

Dear Sirs: Will you please send me by mail one corrugated plate. I need it immediately. The instrument is of great benefit to me in my practice, having cured a great many patients by using the battery that could not be cured by the use of remedial agents, but I have succeeded in every case by the use of the battery. I would not be without it for any money while engaged in the practice of medicine. Please send the plate at once. Direct

JOHN W. PICKETT, M. D., Macon City, Macon Co., Mo.

BALTIMORE, Md., Oct. 16, 1882.

KIDDER M'F'G CO.

Gents: Will you please send me your catalogue and price list of batteries. I occasionally have calls to furnish batteries to my patients, and after an eight years' personal experience with the Kidder, besides seeing and trying many others, I can recommend no other to persons wishing to buy.

Very respectfully, W. T. ROSS, M. D.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED DEC. 16, 1884.

Apparatus for Maintaining Electrical Connection Between a Moving and Stationary Electrical Instrument; C. W. Williams, Cave City, Ky.; G. S. Barnum, Atlanta, Ga., and E. B. Ives, New York, N. Y..... 309,274

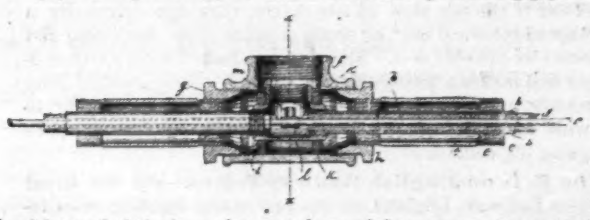
Consists of a flexible electrical conductor extending between the trucks and attached to the car by springs, by which the same is kept taut, adapted to engage, with conducting-surfaces in a line-conductor separate from the car.

Electric Arc Lamp; T. L. Kay, Hamilton, Ontario, Canada..... 309,392

Consists of a vertical iron carbon holder in combination with a solenoid wound with two sizes of wire separated with a suitable insulating substance.

Electric Light Conductor; W. R. Patterson, Chicago, Ill., Assignor to the Western Electric Co., of same place,..... 309,246

The central conductor *a* may be a copper wire. The outer conductor, *b*, is in the form of a copper tube, watertight and should be of about the same conductivity as the inner conductor. The pipe *c* is preferably of iron. An outer protecting-pipe of

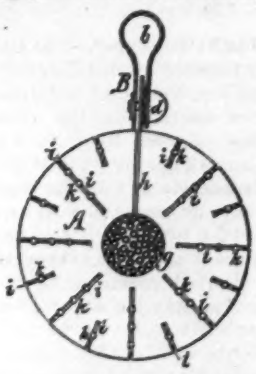


lead instead of the iron pipe may be used, however, with a nipple soldered to the end for making connections with the T-pieces. Between the two conductors are placed the strips, *d*, of wood. These strips are three in number, and are designed to hold the wire at the centre of the conducting-tube. The two conductors are thus held concentric. Between the outer conductor *b* and the pipe *c* are provided similar wooden strips *e*.

Electric Arc Lamp; H. A. Gorn, Cleveland, O., Assignor to W. A. Gabriel, C. O. Evarts and W. T. Sellers of same place..... 309,454

Consists of a carbon-feeding mechanism, of a swinging armature and two electro-magnets, one in the main circuit and the other in a derived circuit, said magnets being both provided with flat rectangular poles, and said armature being arranged to swing in proximity to the corners of said poles.

Electric Wire Support; A. S. Weaver, Providence, R. I., Assignor by mesne assignments to himself and O. N. Bender, of same place, and O. M. Draper, of North Attleborough, Mass..... 309,267



Consists of the insulator *A*, composed, generally speaking, of vulcanized rubber and slotted.

Electric Fire Alarm; R. H. S. Thompson, Lexington, Ky..... 309,262

Consists in making a recess in the end of the cartridge for receiving the terminals of the wires and the fulminating substance.

Compound Wire; F. Chillingworth, New Haven, Conn., and H. G. Russell, Washington, D. C., Assignors to said Chillingworth, W. Paus and T. J. Wood, both of Ansonia, Conn..... 309,439

The inner wire is dove-tailed and passed through a hollow cylindrical wire whose inner surface is also dove-tailed to match.

Compound Wire; W. Paul and T. J. Wood, Ansonia; Assignors of one-third to F. Chillingworth, New Haven, Conn..... 309,509

Claims a compound wire made of a cylindrical tube containing a non-cylindrical wire.

Insulating Electric Wires; M. D. Fermer, Rochester, N. Y..... 309,450

Insulating substance consists of asphaltum, resin, sulphur and alum contained in a trough having one or more removable sides.

Means for Ventilating Test Stations of Underground Cables; W. R. Patterson, Chicago, Ill., assignor to the Western Electric Co., of same place.. 309,245

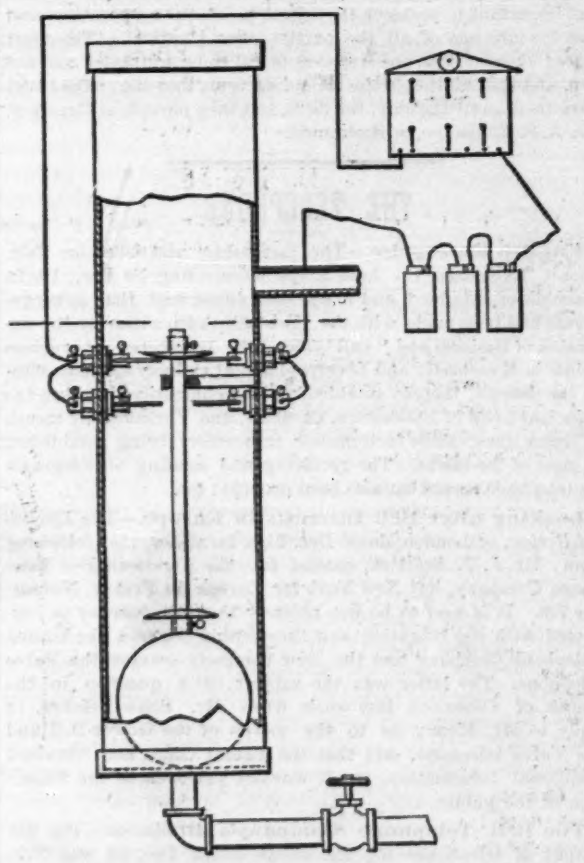
Consists of a cover placed over the manhole and provided with a sleeve and vent-holes, and of a basin situated directly below the manhole.

Method of Making Telegraph Cables; W. R. Patterson, Chicago, Ill., Assignor to the Western Electric Co., of same place..... 309,244

Consists in surrounding the core with an elastic pipe and forcing therein a melted insulating substance and allowing the insulating substance to cool within the elastic pipe, whereby the said pipe is caused to shrink as the insulating substance shrinks in cooling.

Electric High and Low Water Detector for Steam Boilers; C. H. Wickersham, Patterson, Pa..... 309,425

Consists of a galvanized iron stand-pipe, suitably connected with the boiler for circulation of water and steam, and containing a float having a vertical stem of a little greater length than the range between high and low water, and carrying electric conductors, which are brought into contact with conductors located inside of the tube at suitable points for completing the electric



circuit, in which are included a multiplex annunciator, when several boilers are employed, by which all the boilers may be connected in one circuit.

Process of Making Electrodes for Secondary Batteries; W. E. Case, Auburn, N. Y..... 309,293

Consists in first melting the material of which the electrode is to be composed; second, cooling said material in a vessel heated by steam at or near the temperature of said material while in a pasty or viscid state, and stirring said material in said vessel while cooling until it reaches said viscid state; third, pressing said material, while in said viscid state, in form in a suitable mold.

Spring-Jack Switch; R. V. Freeman, New York, N. Y., Assignor to the Western Electric Co., Chicago, Ill..... 309,216

Consists in making the framework of several switches of a single strip of insulating material, preferably wood, and mounting the several springs or contact pieces thereon. The weight of the switches is thereby materially decreased while better insulation between the various parts is maintained, better contacts insured and the cost of construction lessened.

Telephone; J. Lowth, Chicago, Ill..... 309,474

Embraces the broad principle of communicating speech from the exterior parts of the human body to the telephone diaphragm through the medium of a a solid body, such as a metal bar.

Telephone; J. Lowth, Chicago, Ill..... 309,476

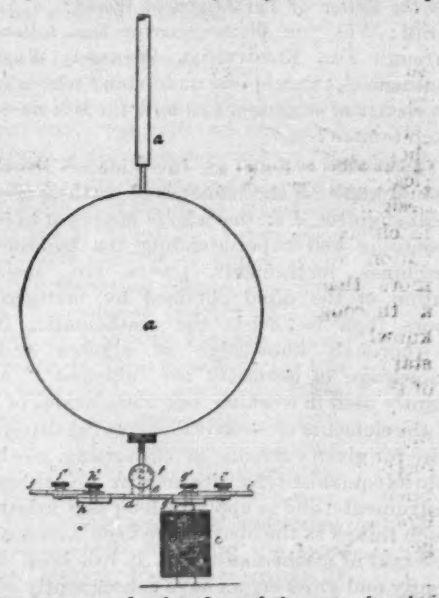
Consists in the combination with a telephone membrane of a knob which is to be applied to the throat while speaking.

Telephone; J. Lowth, Chicago, Ill..... 309,575

This invention is an improvement upon the preceding and consists in the application of a comparatively hard or stiff but vibrating support between the stethescopic vibrator.

Synchronizing Device for Clock Pendulums; W. F. Weisgerber, New York, N. Y..... 309,269

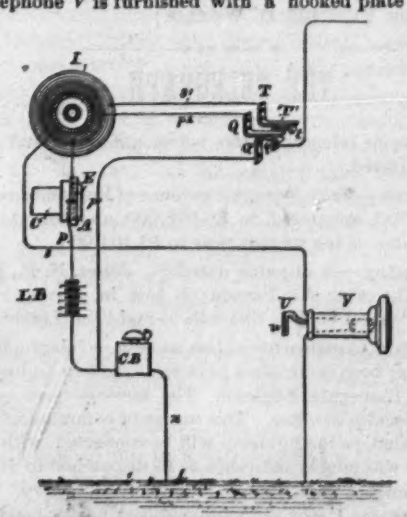
A represents an ordinary pendulum. The electro-magnet *c* is fixed in location directly under the point of suspension. To the lower end of the pendulum-rod is attached the plate *d*, of brass or other diamagnetic material, provided at its centre with the boss *e* and thumb-screw *f*, by means of which it is secured to the pendulum-rod. The two iron armatures *g* and *h* are secured to the plate *d* by means of the thumb-screws *g'* and *h'*, and they are held in transverse position on the plate *d* by means of ribs on their upper sides, which fit into the slots *d' d'*, formed through the plate. Said slots permit of the movement of the armatures to and from the centre of the plate; and to adjust them in position relatively to the electro-magnet *c* two flat scroll-cams *i* and *j* are pivoted on the top



of the plate *d* at its extreme ends, the edges of the cams bearing against the thumb-screws *g'* and *h'* of the armatures.

Telephonic Apparatus; T. J. Perrin, New York, N. Y., Assignor to the National Improved Telephone Co., of New Orleans, La..... 309,357

The telephone *V* is furnished with a hooked plate or plug, *U*,



in its end, of a width sufficient to plug to both switches *Q T* simultaneously, these switches being arranged side by side for that purpose. The upper surface of this plate, *u*, is covered with insulating material, while its under side is a conductor. If the plug *U* be thrust between the jaws *Q q* and *T t* of the spring-switches *Q' T'*, the primary transmitting-circuit will be interrupted by the insulating-face *u*, and the main line will be connected through the under face of the plug, jaw *q*, and the line *p'*, through the call bell *C B*, and then to the earth by the line *x*. In this condition the station illustrated in the drawings may be called.

Winding Rolls of Telegraph Paper; Henry F. Clarke, Brooklyn, N. Y., Assignor of one-half to Ralph W. Pope, Elizabeth, N. J..... 309,332

Consists of a roll of telegraph paper having any number of its central convolutions glued together for the purpose of forming a substantial hub.